CIVIL ENGINEERING

SEPTEMBER 1950

THE MAGAZINE OF ENGINEERED CONSTRUCTION

Free Roads Versus Toll Roads—Jorgensen

Low-Cost Housing Speeded —Kervick and Monroe

ASCE Meets in Chicago —October 11-13

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

MULTIPLE BUCKET swings two 4 cu yd batches out over Genesee River for construction of Corps of Engineers Mount Morris Dam. See article by W. V. Greeley

GOW SOIL BORINGS BY Raymond

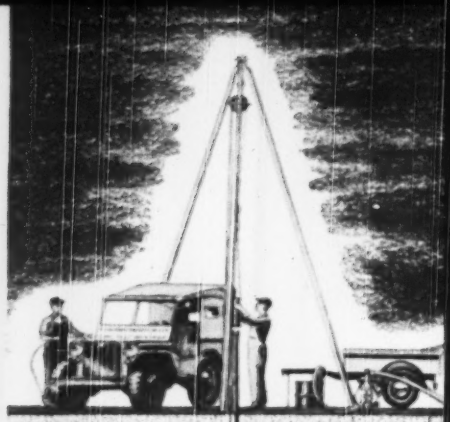
Carefully made soil investigations are of great value to Owners, Architects and Engineers in the selection of building sites and the determination of proper structural foundations.

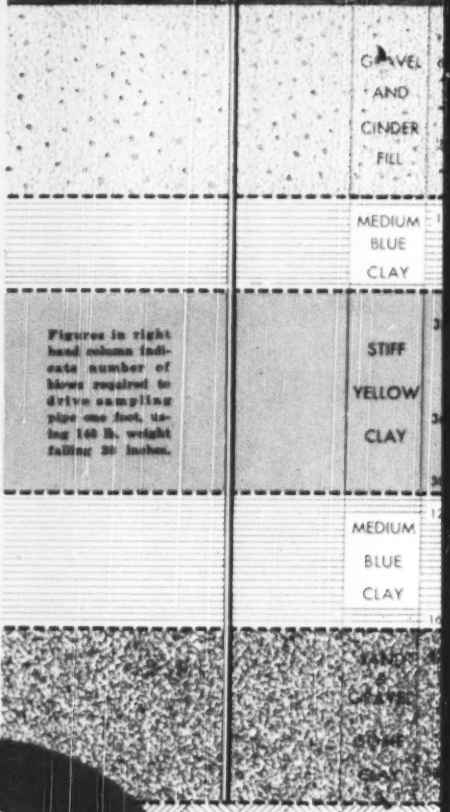
Specify dependable Gow borings by Raymond and you will secure information that will supply the basis for sound engineering decisions.

Their low cost will surprise you.

• • •

THE SCOPE OF RAYMOND'S ACTIVITIES includes, in addition to borings for soil investigation, every recognized type of foundation construction—concrete, composite, precast, steel, pipe and wood piles. Also caissons, underpinning, construction involving shore protection, shipbuilding facilities, harbor and river improvements, and cement mortar lining of pipes by the Centriline Corporation, a Raymond subsidiary.




GRAVEL AND CINDER FILL
MEDIUM BLUE CLAY
Figures in right hand column indicate number of blows required to drive sampling pipe one foot, using 140 lb. weight falling 30 inches.
STIFF YELLOW CLAY
MEDIUM BLUE CLAY
REFUSAL – LEDGE ROCK OR BOULDER

GOW DIVISION

Raymond

CONCRETE PILE CO.

140 Cedar Street, New York 6, N. Y.

BRANCH OFFICES

Boston • Syracuse • Philadelphia • Baltimore
Washington • Pittsburgh • Atlanta • Miami
Houston • Kansas City • St. Louis • Cleveland
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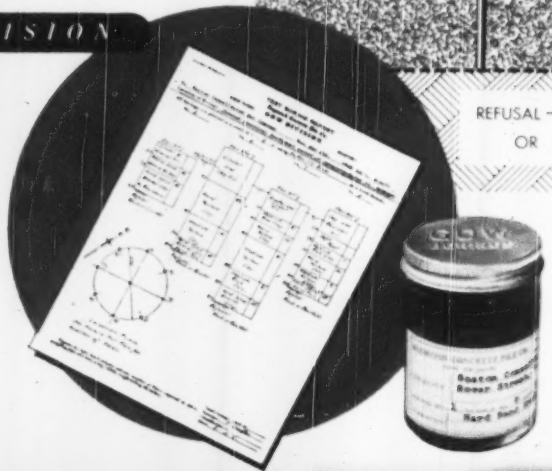
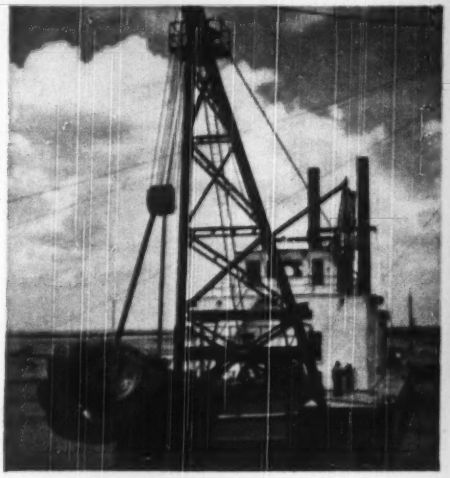
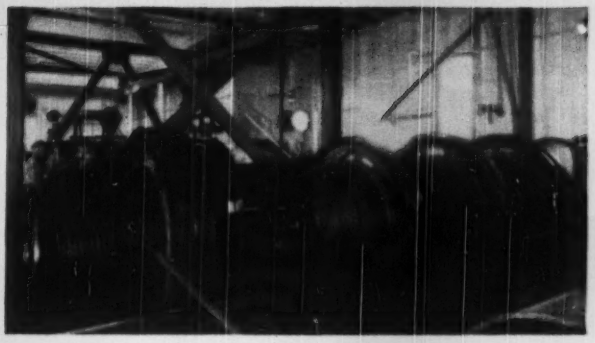
San Francisco • Oakland • Los Angeles
and principal cities in Latin America



View above shows Bucyrus-Erie *hydraulic dredge* installation at work. In foreground on floats are electric cables which supply 6600-volt, 3-phase power to the 4000-hp pump motor, 500-hp cutter motor, and various other motors and control. Below is front-view close-up showing cutter in raised position.





Inside, these hoist cable drums are driven by G-E motors. After ten years of rough duty, this fully electrified dredge continues to give top performance for its owners.

Vacuum-cleaning RIVERS ... *Electrically*

This electrically driven hydraulic dredge is a pretty rugged looking "vacuum cleaner." But biting-into and sucking-up river bottoms is a rugged job—though it does require accurate control. That's why Bucyrus-Erie uses *electric drives* in most dredge installations.

Electrified construction equipment is being used more and more to handle difficult jobs—jobs that require smooth, completely dependable operation. With G-E power distribution systems supplying the voltage and G-E motors and control driving your equipment, you are assured of all the benefits of electrification plus G-E engineering assistance in application, installation, and service—wherever the job may be. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

Ask him Today!

Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.

GENERAL ELECTRIC

654-11

CIVIL ENGINEERING, September, 1950. Vol. 20, No. 9. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 25, 1950, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

The New INTERNATIONAL TD-24

HERE'S WHAT THE

Positive all-weather starting on gasoline, with quick change-over to full diesel operation, all from the seat.

Separate reverse lever for quick change of direction. The tractor moves in the direction the lever is moved.

Self load and run with scrapers of 17-yard capacity—and shift gears on the go with the rolling load.

Cut waste shifting time out of work cycles; provide the best speed for every operation, 8 speeds in each direction!

INTERNATIONAL HARVESTER

INTERNATIONAL

CHAMPION of Crawlers

"The TD-24's work right along on slopes so steep we have to cut them down before other tractors can climb them even without loads," says Bob Rardin of Rardin Brothers, Akron, Ohio. "They are fast tractors, easy to shift and have plenty of power. This combination really moves dirt." His TD-24 was equipped with a bulldozer.

"It will out-buck any tractor I've ever run," says Harold Wooley's operator, Drain, Oregon, "and sure push dirt up hill—and climb steep grades." His TD-24 works regularly on 30% to 50% grades, building mountain roads.

"I wouldn't have anything else," says another Oregon operator. He works for V. R. Russell & Sons of Valsetz. "It's sure fine on bulldozing; best dirt mover I ever got hold of."

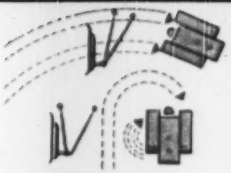
That's the way owners and operators talk about the International TD-24 Crawler. It has earned their praise, for it does everything any other big tractor can do, *plus many things that NO other tractor can do*. The TD-24's versatility makes it the most useful and profitable earth-mover in any equipment line-up.

Visit your International Industrial Power Distributor for a demonstration. Then ask yourself how long you can get along without this big red worker and the extra earnings it will produce.

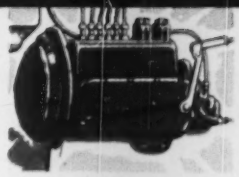
INTERNATIONAL HARVESTER COMPANY
Chicago

TD-24 CAN DO FOR YOU

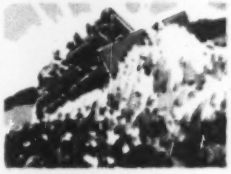
Instant speed change up or down one speed, or stop, without declutching. Planet Power drive does it!



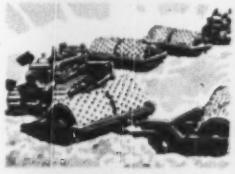
Planet Power steering puts turns with power on both tracks, feathered turns and pivot turns at your fingertips.



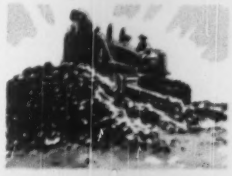
Torque Control feature of fuel injection pump increases engine torque when needed to overcome overloads.



Work on grades up to 100%. Its power, ground contact, balance and lubrication are right for licking any grade.

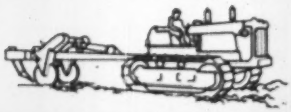


Handle heaviest loads on gradual turns as easily as straightaway because both tracks are powered in the turn!



Push or pull through tough going. The engine delivers extra "power" when its r.p.m. is pulled down by load.

INDUSTRIAL POWER



STAINLESS STEEL CASTING

ELEVEN ACRES OF FOUNDRY FACILITIES

The above 24,000 pound 18% chromium and 8% nickel stainless steel hydraulic turbine runner casting was recently produced in the Newport News foundries for the Hoover Power Plant in Nevada.

Eleven acres of foundry facilities including modern sand handling, mold making and melting equipment, are available for producing castings. In addition to metallurgical laboratory facilities for physical and chemical analysis, Newport News is equipped with Gamma-Ray, Radiograph and Magnaflux equipment to assure thorough inspection of foundry products.

Your inquiries for stainless steel, iron, steel and brass castings will receive prompt attention.

NEWPORT NEWS

Shipbuilding and Drydock Company
Newport News, Virginia

Q HOW MANY DAYS IN A WEEK?

A "TWENTY-ONE," says Geo. W. Longfellow

Mr. Longfellow is right—when you look upon twenty-four-hour going as the equivalent of three normal working days. That is the equipment-torturing schedule followed on the channel relocation project at East Alton, Ill.

Speaking with pride of the recently installed "Cat" D386 Engine that drives his big Bucyrus-Monighan walking dragline, Mr. Longfellow said: "She's working a '21-day' week, has plenty of power—and can really take it."

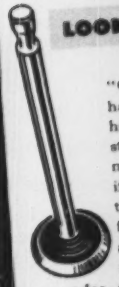
Running continuously for long stretches at varying capacities is one of the performance feats so typical of "Caterpillar" Engines. Delivering their full horsepower output whenever called upon is another. Compactness, easy installation, economical fuel consumption, minimum maintenance costs, and almost incredibly long life are still other advantages for high production and maximum profits. They are swaying contractors everywhere toward specifying "Cat" Engines with the new equipment they buy and to replace "ailing" or inadequate units in old equipment.

A "Cat" Diesel may be just the thing for giving *your* crane, shovel, dragline or dredge a new lease on life—or the extra power it needs to make it more productive. Let your "Caterpillar" dealer make a survey and a cost estimate. He's as near as your telephone.

CATERPILLAR • PEORIA, ILLINOIS

The powerful "Cat" D386 installed in the Longfellow dragline develops 488 hp. max.; 360 hp. rated; 320 hp. continuous, at 1300 rpm. and with full equipment except radiator fan.

LOOK UNDER THE HIDE



"Caterpillar" intake and exhaust valves are made of highly alloyed, heat-resistant steels. Their ample size, close machining and heat-treat specifications have resulted in thousands of hours of trouble-free valve operation. Valve and rocker arm designs are matched to reduce wear. *Look under the hide for "Caterpillar" quality and long-life features—they may not show on the outside but they show up in performance.*

CATERPILLAR

DIESEL ENGINES • TRACTORS
MOTOR GRADERS • EARTHMOVING EQUIPMENT

Without bursting strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON PIPE

Strength factors of Long Life !

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

SHOCK STRENGTH

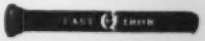
The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

CRUSHING STRENGTH

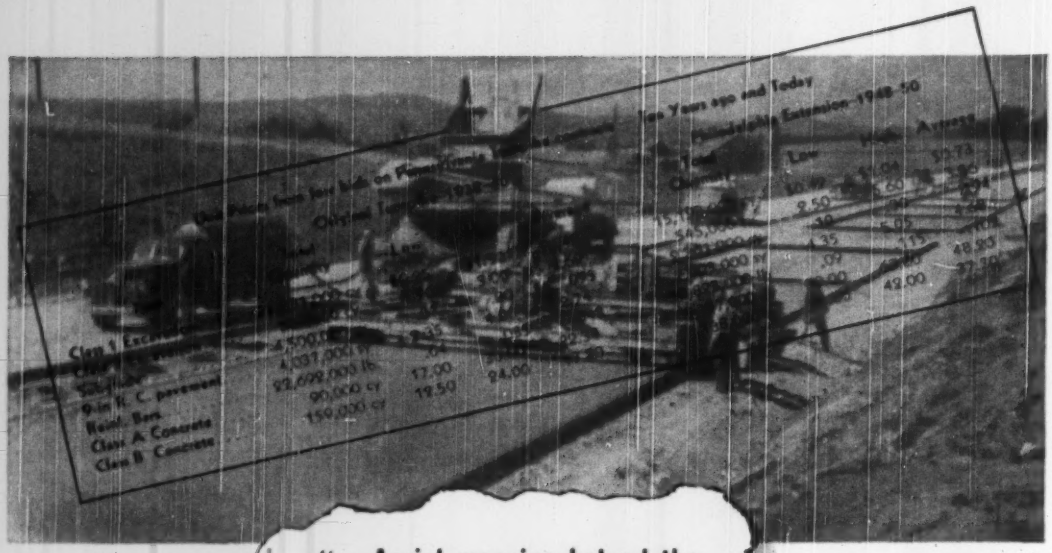
The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.



SERVES FOR CENTURIES



E. H. H. photo

"...Aerial mapping helped the location. The map took five months to produce, about one-fifth the time needed for a ground-surveyed map; it cost about one-fifth, too."*

* *All data and charts from Engineering News-Record for June 15, 1950— "Penn Turnpike Stretches East."*

TODAY turnpike construction costs are up 37 percent over ten years ago, says *Engineering News-Record*. Every cost is up . . . except one! Turnpike aerial mapping costs about one-fifth as much as ground surveys—can be done in one-fifth the time.*

That's AERO SERVICE MAPPING. AERO SERVICE SPEED AND ECONOMY! And that's why AERO maps for large oil and mining interests in Alaska and Canada—in Venezuela and the Caribbean—in Portuguese East Africa and Tunisia—in the Union of South Africa and the Middle East.

And at home—AERO maps for large steel companies . . . timber interests . . . railroads . . . power companies . . . strip mines . . . city planners . . . highway departments of many states.

Mapping for industry is our business. Let our engineers help your staff advance exploration or development schedules by many months.

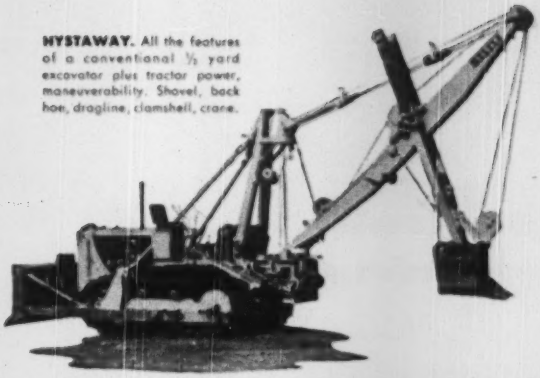
AERO SERVICE *mapping is the only construction cost that is down.* Write AERO SERVICE today.

AERO MAPS THE FUTURE

AERO
SERVICE CORPORATION
236 E. COURTLAND ST., PHILA. 20, PA.
Oldest Flying Corporation in the World

TOPOGRAPHIC MAPS • PLANIMETRIC MAPS • PRECISE AERIAL MOSAICS • AIRBORNE MAGNETOMETER SURVEYS • RELIEF MODELS • COLOR PHOTOGRAPHY

29 HYSTER TRACTOR TOOLS



HYSTAWAY. All the features of a conventional ½ yard excavator plus tractor power, maneuverability. Shovel, back hoe, dragline, clamshell, crane.

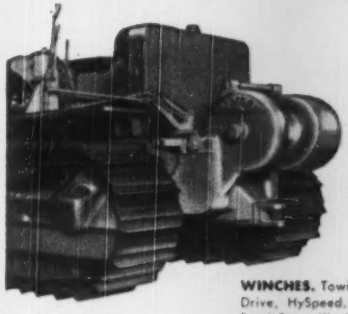
Any one of them makes your "Caterpillar" Diesel Tractor

do double duty

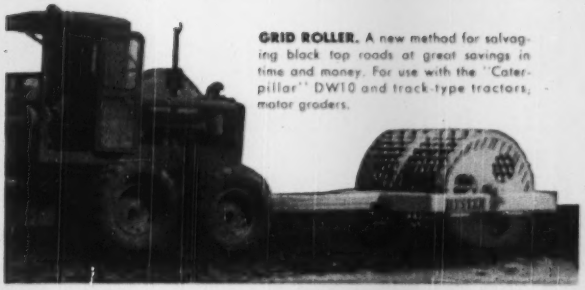
Mounted on either a new or an old "Caterpillar" Diesel Tractor, a Hyster tractor tool gives a greater range of uses and increases your profit possibilities.

The current line of 29 Hyster Tractor Tools includes the Hystaway; the Grid Roller; and a complete line of winches, yarders, donkeys, cranes, logging arches and sulkies.

Your "Caterpillar" distributor sells and services Hyster tractor equipment. See him for information or write for catalogs. The coupon is for your convenience.



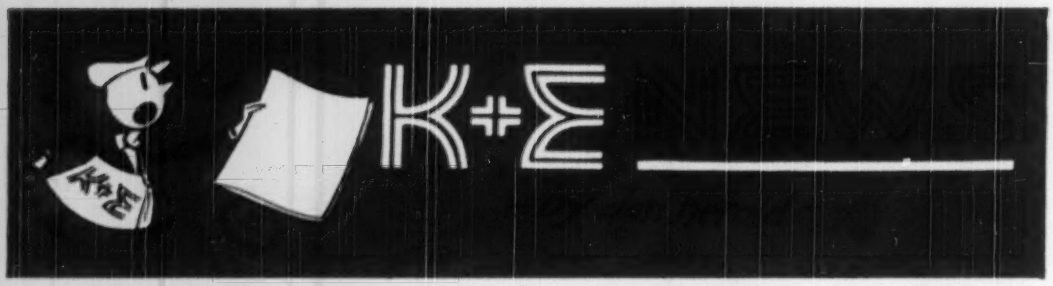
WINCHES. Towing, Utility, Worm Drive, HySpeed. A complete line for "Caterpillar" Diesel Tractors.

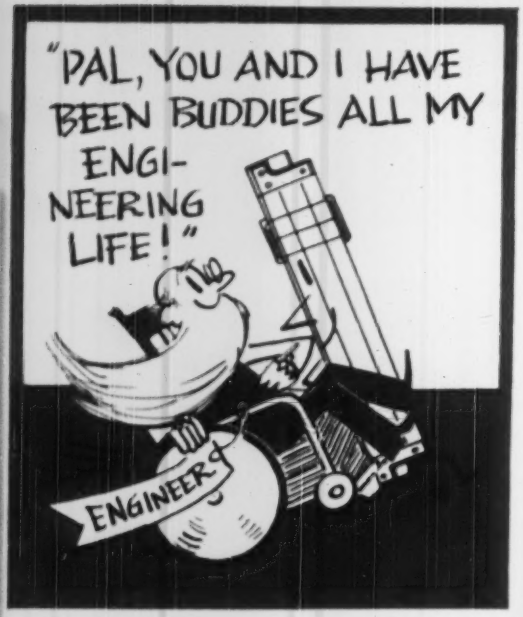


GRID ROLLER. A new method for salvaging black top roads at great savings in time and money. For use with the "Caterpillar" DW10 and track-type tractors, motor graders.

HYSTER COMPANY
2999 N. E. Clackamas St., Portland 8, Oregon
Please send catalog on HYSTER Tractor Equipment for
☐ Construction ☐ Industry ☐ Oil Fields ☐ Heavy Logging ☐ Light Logging
Name _____
Address _____
City _____ Zone _____ State _____

HYSTER® COMPANY
2999 N. E. Clackamas . . . Portland 8, Oregon
1899 North Adams Street . . . Peoria 1, Illinois





Down through the years with a K&E Slide Rule

Although K&E Slide Rules are the oldest slide rules made in America, there are no whiskers on 'em—except cat's whiskers (I mean, symbolizing precision).

If you are an old engineer, you probably regard your K&E Slide Rule as a priceless Stradivarius. You are probably figuring on passing it down to your grandchildren.

If you are a beginner, the sooner you attach yourself to an immortal K&E rule, the better.

K&E Slide Rules have become accepted symbols of the engineering profession. If a photographer, illustrator or cartoonist wants to indicate that his hero is a top-flight engineer, he puts a K&E Slide Rule in his hand or in the immediate environment.

Ask anybody what he knows about Keuffel & Esser, and he first starts rhapsodizing about slide rules. Slide rules and K&E are synonymous.

And they're both almost as long lasting as the pyramids!

Keuffel & Esser have been around since 1867 and they completed their first batch of slide rules in 1891.

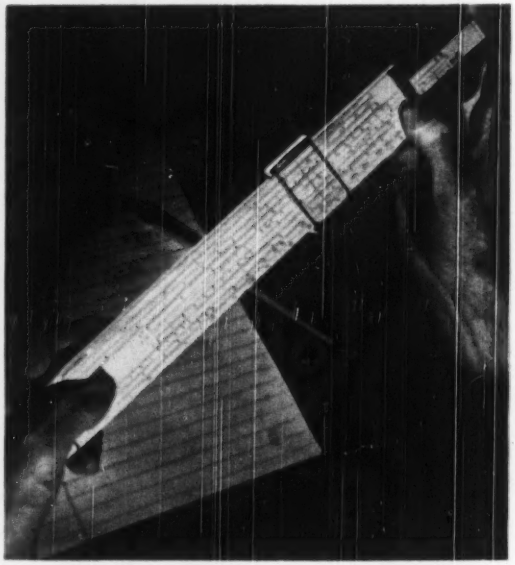
It is not uncommon to hear of a K&E rule which has been in service for over 50 years.

I used to think a slide rule was a slide rule—just as a yard stick is a yard stick—but there is a sensational variety of 'em in the K&E line—from the simple Mannheim to the more complicated brethren, such as the Log Log Duplex Trig and Decitrig and the Log Log Duplex Vector*.

Also, there are several sizes from the handy pocket rules, to the more common 10-inch, up to the 20-inch longfellows.

There's no point to hitching up for life with a "second best" slide rule when you can play a Keuffel & Esser.

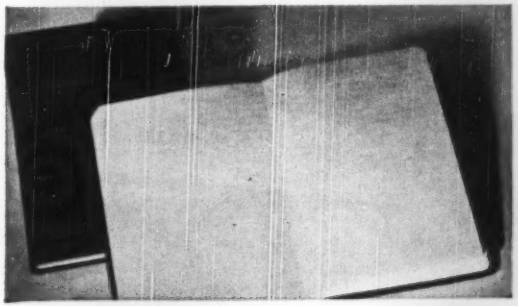
* Trade Marks (R)

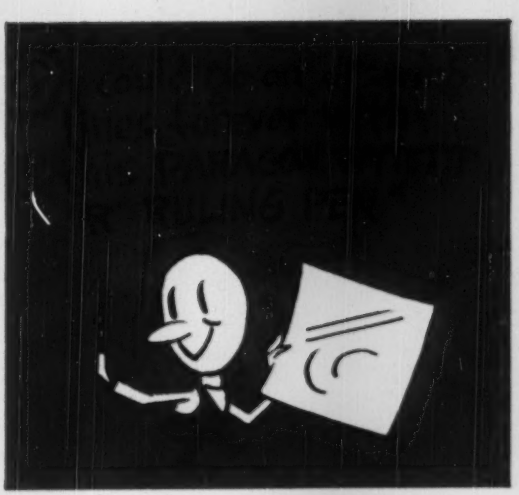


K&E Engineers' Field Books are built to take a beating. They are constructed to withstand rain, snow and perspiration—and a rough life in a man's hip or side pocket—and back-breaking acrobatics in everyday life.

You can fold one of 'em backwards, cover to cover, for easier writing, and nothing will crack. The sections are stitched with rustproof wire to the tough canvas backbone.

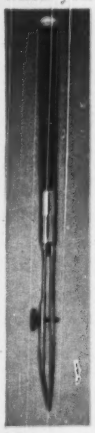
The paper is either 100% or 50% clean white rag stock with a waterproofed surface. Both are very strong, give you an excellent writing surface and will not turn yellow or brittle with time. These books are usually referred to over and over again for many years. The rulings are printed in waterproof ink which will not blur with moisture. Yes, a K&E Field Book is made to be an engineer's pal in his rigorous outdoor life.





You lucky engineers—with K&E ruling pens!

In my business as a cartoonist, all I have to play with is a 5-cent stub pen. But you engineers can enjoy a fine, precise, beautiful little surgical instrument when you have nothing more to draw than a straight or curved line.



I could drool several paragraphs over a K&E PARAGON* WYTETIP "R" RULING PEN. But space limits me to a few of the things that make it unique. It has points of high-speed steel butt-welded to blades of stainless steel. This makes it a real metallurgical masterpiece!

The high-speed steel points will wear almost indefinitely—which means that the WYTETIP "R" practically never needs resharpening. The stainless steel blades defy corrosion and give the pen eternal spring and resistance.

You can tell it on any drafting table by its smart black handle and distinctive white tip. *Trade Mark

K+E
partners
in creating
For 83 years K&E equipment and materials have been partners of the draftsman, engineer and scientist in shaping the modern world.

LOST: 19 FEET OF WATER IN THE HEART OF TEXAS

Photo courtesy Corps of Engrs., Galveston, Texas District

You're looking at BELTON DAM TEST PIT #2 — Belton, Texas — where a MORETRENCH WELLPOINT SYSTEM operated so effectively that water was lowered to within 1 foot of the rock found at subgrade. Sandbagging took care of the rest. Test hole explorations went ahead "in the dry."

This was a difficult job because of adverse soil conditions. The contractor, Russ Mitchell, Inc., Houston, Texas, knew from past experience that he could count on MORETRENCH to handle the pumping perfectly.

Confidence like this is earned . . . a good thing to remember when you're in the market for wellpoints!

CATALOG ON REQUEST

MORETRENCH CORPORATION

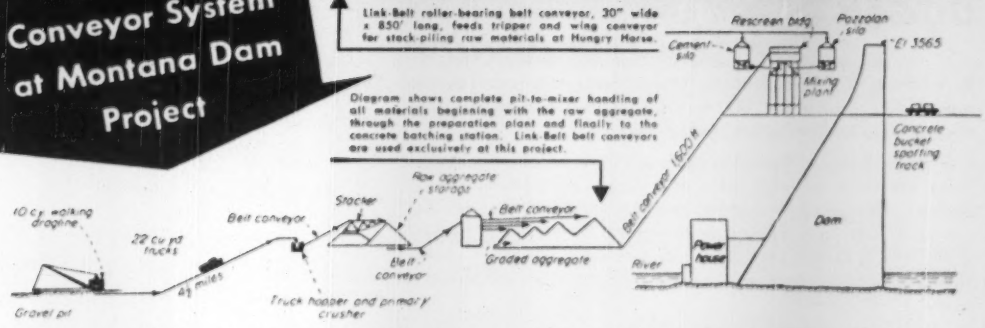
90 West St. New York 6 | 1900 S. Austin Ave. Chicago 38, Illinois | 7701 Interbay Blvd. Tampa 9, Florida | 315 W. 25th St. Houston 8, Texas | Rockaway New Jersey

LINK-BELT

Belt Conveyors Feed Aggregate to HUNGRY HORSE

Conveyor System at Montana Dam Project

Link-Belt roller-bearing belt conveyor, 30" wide x 850' long, feeds tripper and wing conveyor for stock-piling raw materials at Hungry Horse.



Pick Montana as the site for the world's fourth largest dam and you get a job calling for action aplenty in the limited work season; a job demanding efficiency and durability in conveyor equipment.

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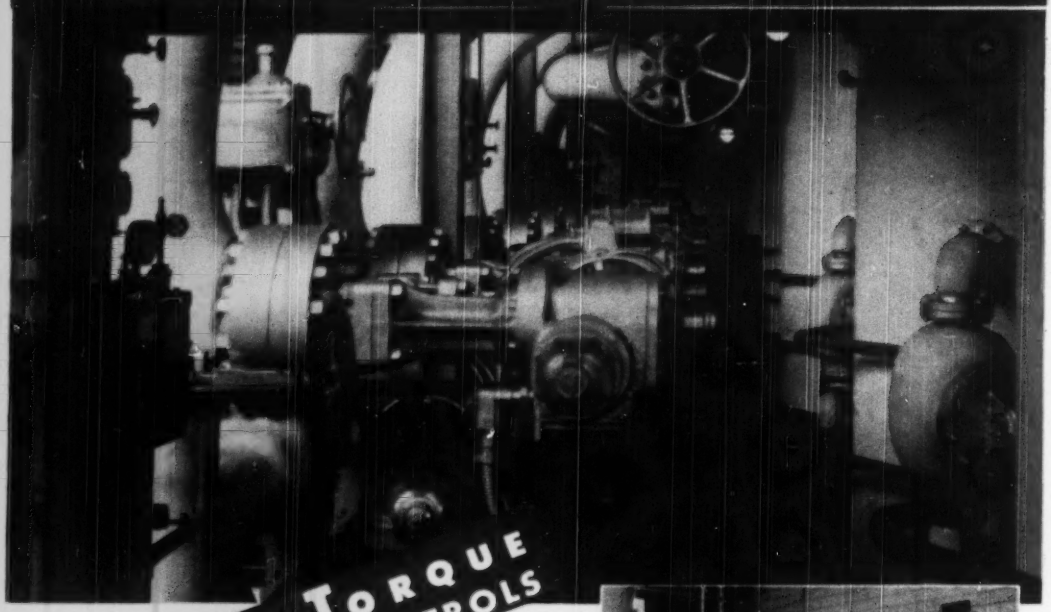

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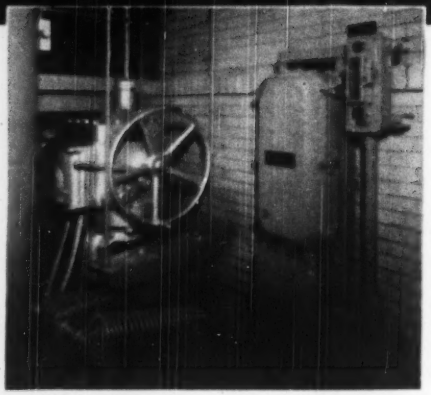

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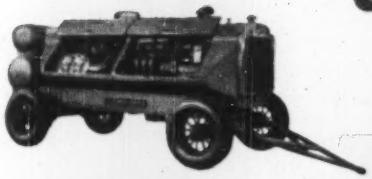

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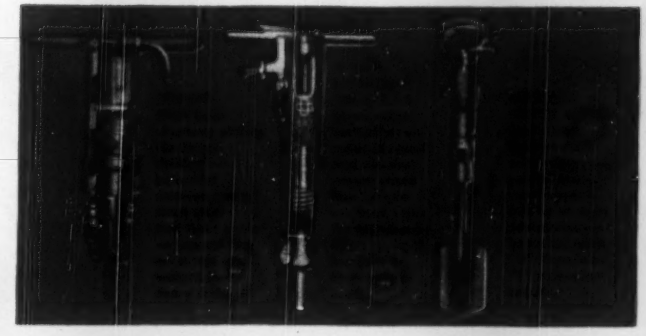

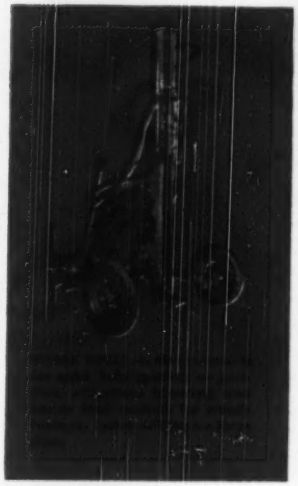

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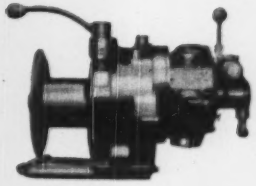

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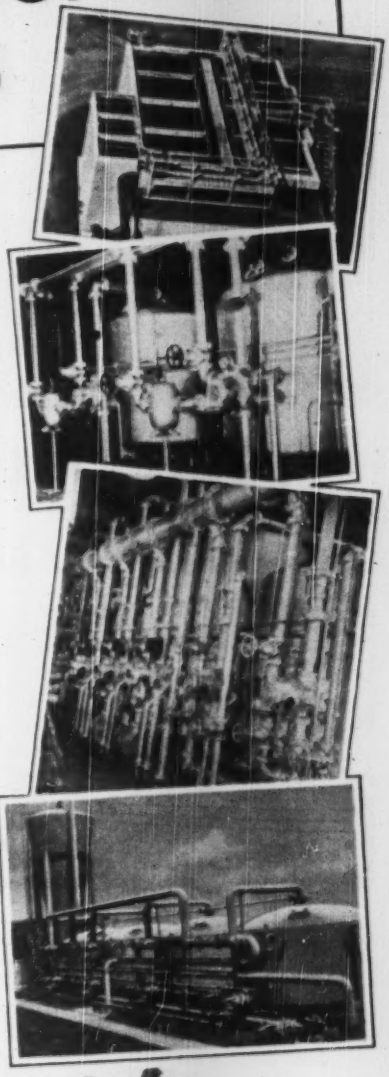

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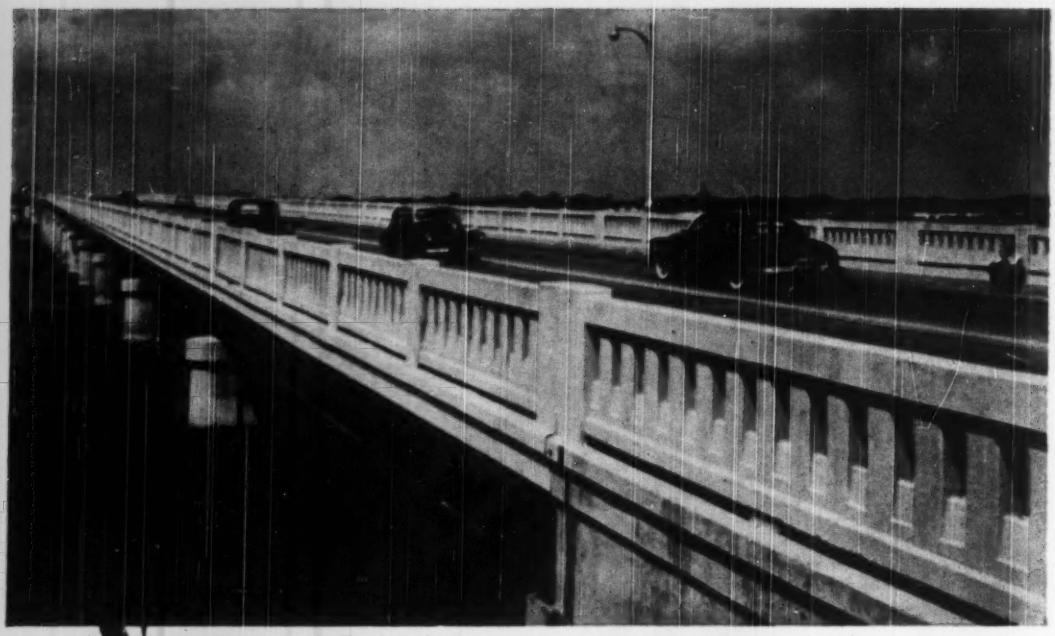

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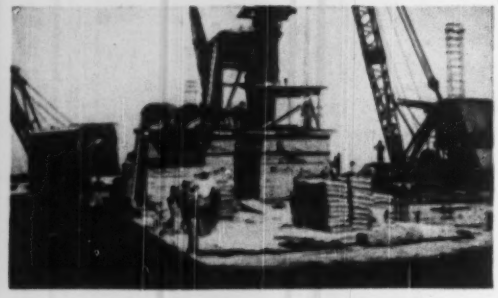

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• *In This Issue*

What Is Being Done to Meet the Housing Shortage?
Government Loans Stimulate Public Housing Through Local Initiative . . . *John A. Kervick* 21
Mass Production Methods Reduce Construction Costs of Private Housing . . . *C. A. Monroe* 22
The Plant Engineer—Jack of All Trades and Master of Many . . . *James C. Begg* 25
Steel Sheetpile Cells Form Bulkhead for Long Beach Harbor Expansion . . . *R. R. Shoemaker* 26
Volcanic Clinkers Stabilize Fills on Hawaiian Highway . . . *R. M. Beit* 30
Construction Plant at Mount Morris Dam Organized to Meet Rigid Specifications . . . *W. V. Greeley* 32
King-Sized Venturi Measures New York's Water Supply . . . *Walter J. Gress* 37
Free Roads Versus Toll Roads . . . *Roy E. Jorgensen* 40
Diagram Determines Pipe Sizes Directly . . . *Ralph W. Powell* 45
Vacuum Breaker Prevents Back Siphonage to Potable Water Supply . . . *F. W. Macdonald* 46
Program of ASCE Meeting in Chicago . . . 50

• *Society News*

Centennial of Engineering, 1952, Inc., Is Headed by Lenox R. Lohr . . . 54
ASCE-AGC Joint Cooperative Committee Meets in Toronto . . . 55
ASCE Hydraulics Division Furthers Meeting Plans . . . 55
Illinois Section Members Plan ASCE Chicago Meeting . . . 55
Engineers to Advise Civil Service Commission . . . 56
Society Members in Maine Form Local Section . . . 57
Board Studies Proposed Change in Code of Ethics . . . 57
From the Nation's Capital . . . 58
News of Local Sections . . . 62

• *News Briefs*

Contractors and Government Agencies Confer on Defense Measures . . . 66
Construction Activity Reaches New High . . . 66
Chicago Improvements to Expedite Traffic in Loop District . . . 67
New Army Building Is Designed for Use in Arctic Climates . . . 68
NSPE Issues Statement on Professional Bargaining . . . 68
New York Water Board Opposes Use of Hudson River Water . . . 70

• *Departments*

Engineers' Notebook . . . 45
The Readers Write . . . 47
New in Education . . . 74
N. G. Neare's Column . . . 76
Deceased . . . 78
News of Engineers . . . 80
New Publications . . . 85
Men and Jobs Available . . . 88
Meetings and Conferences . . . 90
Positions Announced . . . 92
Recent Books . . . 93
Equipment, Materials, Methods . . . 96
Literature Available . . . 107
Index to Advertisers . . . 114

Proceedings Papers Available as Separates 109

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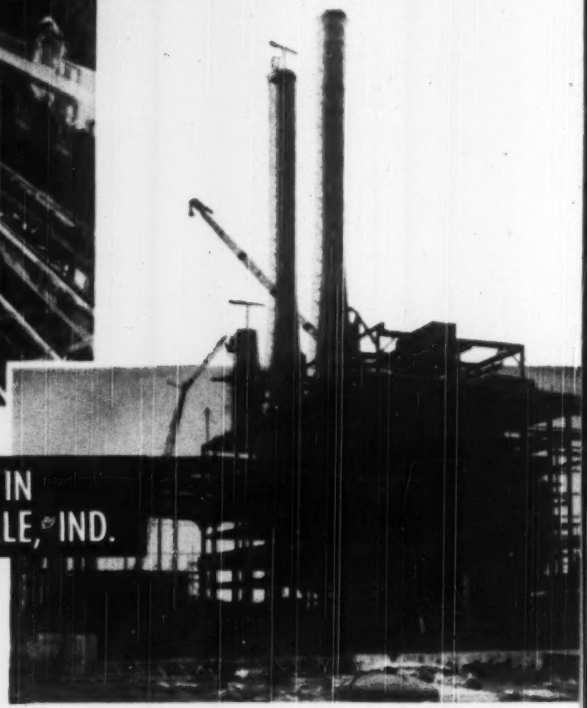

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What Is Being Done to Meet the Housing Shortage?

HOUSING POSTWAR AMERICA is still a vital problem which both the government and private enterprise have endeavored to solve. The most recent governmental attempt at a solution is the Housing Act of June 1949, which assigns a responsible role to engineers and city planners in its slum clearance and rehabilitation provisions. This congressional legislation provides for the construction of 810,000 low-rent housing units for low-income families at a cost of approximately six billion dollars. To date, President Truman has approved loans and grants to 496 localities covering 271,000 dwelling units. About one-third of the entire program is actually under way. In the first of the two following articles, the Director of the PHA's New York Field Office discusses the terms, aims, and expected results of Titles I and III of the Act, which deal with slum clearance and rehabilitation and low-rent housing. The government is authorized to make loans for acquiring, clearing, and preparing slum lands for reuse and to make grants up to two-thirds of the net cost. Initiative for the projects must come from local authorities, who also contract for planning and construction.

Private industry's contribution to the housing effort is low-cost mass production, well illustrated by the methods used in building the mammoth Levittown described in the second article. The procedure used for constructing these site-fabricated houses closely parallels that of a factory assembly line, except that the workmen move along from job to job. Each workman specializes in a particular operation so as to develop maximum efficiency, and an incentive system reduces costly supervision.

Government Loans and Grants Stimulate Public Housing Through Local Initiative

JOHN A. KERVICK

Director, New York Field Office, Public Housing Administration, New York, N.Y.

TWO BASIC NEEDS of the United States, to which the Housing Acts of 1937 and 1949 are oriented, are:

1. Progress toward a decent home in a good environment for every American family.

2. Stabilization of employment in the residential construction, building materials and related industries through development of a long-range low-rent public housing program scheduled over a period of years, rather than for an enormous volume in a few years.

In Europe many major industrial and commercial cities and seaports are in process of being rebuilt on modern lines because the war's destruction of the older and more congested areas of those cities has afforded the municipal engineers and planners an opportunity for modern scientific replanning.

Yet, in the United States, from Galveston to Boston, and from Portland, Me., to Portland, Ore., there has been far too little significant redevelopment of our major cities. This is due to a number of causes, but primarily to the fact that there had not been devised the financial and rehousing tools required for the task. These difficulties are being ameliorated to a certain extent. The states, in their housing enabling acts, and the federal government in the Housing Act of 1949, have provided the tools and developed a pooling of federal, state and local powers and resources which now challenge the engineer, the architect and the planner to put these tools to work.

By and large, urban redevelopment under Title I of the Act, "Slum Clearance and Urban Redevelopment," is a civil engineering job, whereas in low-rent housing, under Title III of the Act, "Low-Rent Public Housing," the architect takes the leadership. Under both titles, engineer and architect have a vital function to perform.

This Is Local "Home-Rule" Housing

These activities, whose origins are about 13 years old, represent a new development in federal public works. Traditionally, federal programs have been concerned with river and harbor improvement, aforestation, interstate irrigation and water conservation, etc. Obviously, these are national responsibilities which cannot be efficiently and comprehensively undertaken by individual states.

When it comes to slum clearance and urban redevelopment, the American citizen is hit where he lives—in his own home town. This called for the development of a program of federal aid, but only where citizens in their own communities undertake to initiate, execute and operate a plan of urban redevelopment, slum clearance and low-rent public housing for families of low income whose dwelling environment constitutes a menace to their neighbors and creates an economic blight on the business welfare of the community.

That is why the federal programs as set up by the U.S. Housing Act of 1937 and by the Housing Act of June 1949, are predicated upon execution by local public agencies, authorized and empowered under state laws. They are administered by local boards composed of local citizens, appointed by local governing officials, and having the cooperation of local governing bodies. Whether they are local housing authorities or urban redevelopment commissions, the initiation of any activity is their exclusive responsibility.

Subject to the approval of governing bodies, local agencies acquire and clear substandard areas of slum and inadequate housing, then replan and dispose of such lands for redevelopment in accordance with the local scheme of redevelopment. The role of the federal government is limited to the provision of financial assistance and such supervision as will assure that the purposes of the federal Acts and aid are achieved.

Similarly, it is to local housing authorities, authorized and established under state laws, that the responsibility for initiating, constructing, owning and operating low-rent public housing is entrusted.

It is not necessary to discuss the social aspects of this program with practicing civil engineers. There is general agreement that slums and blighted areas in American cities are a

HOME BUILDING has been stimulated both by government loans to home-owners and by efforts of private construction industry. Mass production methods give economical construction of site-fabricated houses at Levittown, Long Island, N.Y., as described in following article by C. A. Monroe. At top, trenching machine digs ditch for Levittown curb. Workmen follow behind to place wooden forms, after which curb concrete is poured directly from transit-mix truck, seen in view immediately above.

civic liability and economic waste, which take far more than their proportionate share of public revenue for welfare services, while they are at the same time revenue-deficit areas.

Title I of the 1949 Act, "Slum Clearance and Urban Redevelopment," is administered by the Administrator of the Housing and Home Finance Agency, and makes possible for the first time in our history a comprehensive attack on slums and blighted areas by local communities on a national scale. Emphasis is placed on the elimination of unsafe, unsanitary and inadequate existing housing. The federal government is authorized to make loans for acquiring, clearing and preparing slum lands for reuse, and to make federal grants to pay up to two-thirds of the net cost incurred. But it is an agency of a local government that performs the actual work.

Federal assistance under Title I is also provided under certain conditions for non-residential blighted areas and other areas. Any federal assistance under Title I requires that each locality must have solid, comprehensive redevelopment plans of its own to insure orderly community growth, prevent the recurrence of slums, and stabilize and protect property values and investments in the future. Each community must also have detailed plans, approved by the governing body of the locality, for the redevelopment of the area involved, and these plans must conform to the general plan for the development of the locality as a whole. For this task, the services of engineers will be contracted for, directly or indirectly, by each locality receiving federal assistance under Title I.

When slum areas are to be removed, relocation into decent quarters is required for those leaving the slum areas. It is here that Title III, "Low-Rent Public Housing," plays an important role. This section of the Act provides financial assistance to localities for the construction of dwelling units in which priority must be given to low-income families displaced by slum-clearance projects, together with families of veterans and others of low income living in substandard housing.

This program is not new; it was begun under the U.S. Housing Act of 1937, under which about 192,000 units were provided in some 268 localities. The Housing Act of 1949 amends the 1937 Act to authorize financial assistance for 810,000 additional units in a six-year program, to be initiated, constructed, owned and operated by local housing authorities which have been established pursuant to state law. Such Local Housing Authorities have been authorized in 43 states, Alaska, Hawaii and Puerto Rico.

When a local authority has determined the need for low-rent public housing in its locality, and such need is not being met by private enterprise, it files an application with the PHA for the number of dwelling units it deems necessary, and applies for a temporary loan to process the planning. When the application is approved, the machinery is set up for the development of

(*Continued on page 92*)

Mass Production Methods Reduce Construction Costs of Private Housing

C. A. MONROE, M. ASCE

Chief Engineer, Levitt & Sons, Inc., Manhasset, Long Island, N.Y.

MASS PRODUCTION of low-cost homes has been developed to a high degree at Levittown, Long Island, N.Y. Starting with potato fields in 1947, the project now contains over 10,000 homes and has a population of about 35,000 people. The houses are site fabricated, with as many of the components as possible shop cut. The operations performed by each workman are reduced to a minimum as in a factory assembly line, except that instead of having the work move past the workman as in a factory belt system, in this case the workmen move along from job to job. Of equal significance is the fact that the project is done on a piece-work basis, which is an incentive for increased efficiency and consequent reduction of cost.

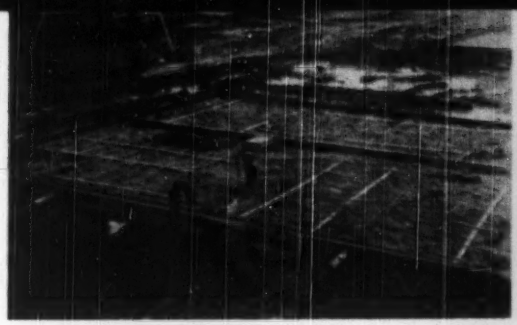
The project, built by Levitt & Sons of Manhasset, L.I., now covers four square miles, and is still growing. Ultimately 60,000 people may be housed here.

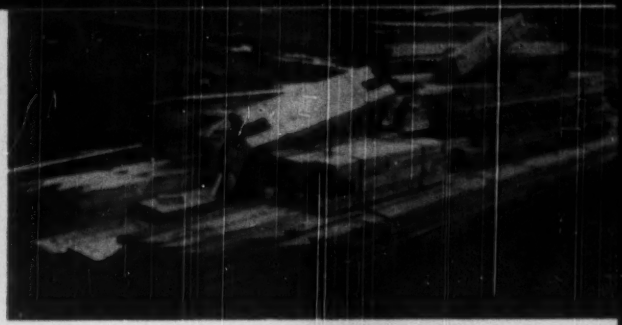
In choosing land for a large-scale housing development consisting mainly, if not entirely, of individual homes, various factors are to be considered. The site should be as close as possible to a large population center, keeping in mind that large tracts of land consisting of contiguous parcels must be available. The cost should be low and the land suitable for quick and easy development. Reasonably good transportation should be available.

It is desirable to have such utilities as gas, electricity and water supply available, but if the project is large enough, utilities can be created.

The land should be fairly flat or gently rolling, and preferably the latter to permit road grades to follow the natural contours, allowing for natural drainage with a minimum of excavation for road grading, and at the same time a minimum of plot grading. For rapid construction progress, sites should not be heavily wooded.

If the project is a production job such as the building of 4,000 homes per year at Levittown, the effect of every detail on production in general must be considered. The construc-





tion procedure in building houses on such a vast scale closely parallels the production line of a large automobile factory. Every detail that is not properly planned to tie in with the general construction plan will slow up the job, and serious or frequent tieups can easily bring the work to a stop and cause the builder's economic ruin. Standardization must be carried to a high degree, and construction details must be simplified as much as possible so that they can be understood by all workmen.

In planning for large-size subdivisions or communities, builders must provide business and recreational areas adequate to serve the needs of the population housed, as well as other community facilities.

In the case of Levittown, 10,000 single-family homes had been completed by the end of 1949—all built in less than three years. Serving these homes, and built simultaneously with them, are three interior shopping centers with ample parking, all the stores being air-conditioned. Six large swimming pools of modern design have been completed. Ten large park sites have been provided, placed strategically throughout the community. Two of the park sites have been developed as ball fields and playgrounds. About a dozen church sites have been donated. The community has its own water supply system consisting of eight wells and pumping stations for residential use, and three wells and pumping stations in the business centers. Sewage disposal is by the usual cesspool or septic tank and tile field. It took about 2,300 acres of land to develop 10,000 homes, or about $4^1/_2$ homes to the acre, on plots with a minimum size of 60 ft × 100 ft.

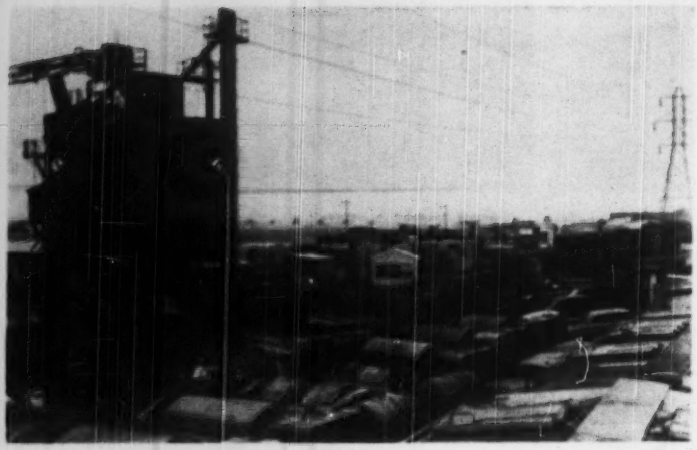
In a large-scale development of one-family houses, a larger area is involved than may appear at first glance. To build 4,000 homes, or a few more per year, an area of 1,000 acres, or $1^1/_2$ sq miles, is required. This is quite a different matter from that of building vertically, as in apartment-house construction, where the activity is concentrated on much less acreage. To build houses requires a tremendous amount of land planning and the construction of miles of roads, drainage and utilities such as electricity, gas (if used), water supply and water mains, sewage disposal and sewers (if used). The planning for and installation of these improvements is almost as big a job as the building of the houses. And it is very important that this work be coordinated with house construction.

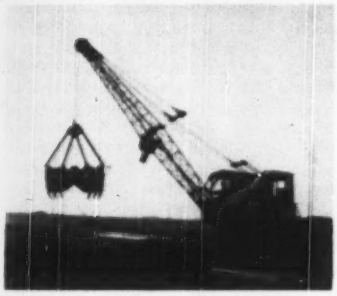
Grading, road paving and utility installation must be kept in advance of house building, otherwise the work is impeded and at times halted. The difficulties involved in delivering materials to building sites where suitable roads have not yet been constructed are easy to understand. Also, workmen must be able to get close to the job site. Almost every house design requires a certain amount of masonry work, which is dependent on the water supply, so it is necessary to have the water mains ready to meet such demands.

Apart from architectural or social requirements, the following design principles must be observed in building small houses for mass production. The design must of necessity be simple, must permit of easy standardization in every detail, and must utilize only materials that are readily obtainable and that are understood by the workmen. Most important, construction methods must be simple and easily grasped by the average workman. Complicated construction methods and unfamiliar materials must be ruled out. The whole design must fit into a pattern of mass production from start to finish.

One detail of outstanding importance in the design of the small house

RADIANT HEATING COILS in floor slab (above left) are delivered to construction site cut and bent to shape. Floor slab will rest on footings already poured. Utilities, foreground, are installed before work begins on house. Lumber is precut and delivered to site in one-house bundles (above, right). Truck (right) delivers window frames to each house site. Because of close delivery schedules, all streets are poured and ready for truck traffic before work starts on houses. Completed houses (below), built in quantities of 4,000 per year at Levittown, are type well suited to mass production. Interior is standardized, but variation in roof lines gives effect of variety. House sells for $7,990. Television in each house and free swimming pools are also supplied by builder.





MASS PRODUCTION methods involve use of large equipment and large quantities of material for small-house development at Levittown. Batching plant (left) is capable of producing 2,000 cu yd of concrete per day, in project where only about 18 cu yd are needed for each house. Other concrete is used in pouring streets, sidewalks, and curbing. Note railroad cars in lower right used to transport bulk cement and lumber. Crane and clamshell (below) move down street digging cesspools. Excavations are completely filled before house construction begins.

at Levittown is the item of foundation and floor. There are no cellars under the houses. The concrete floor slab is the foundation as well as the floor although, of course, there are footings around the edge of the floor. This design eliminates the necessity of digging large excavations and pouring concrete cellar walls, with all the attendant problems of tieing up the job with large holes in the ground and piles of dirt all over the site.

The method of building used at Levittown is called site fabrication, although many items are precut or shop fabricated before delivery to the job. All roof rafters and framing lumber are precut and delivered to the job in a "one-house package. Rough plumbing assemblies are made up at the shop and delivered to the site for quick and easy installation. Heating coils for the radiantly heated floor are bent to shape at the shop and delivered ready for installation, which takes about 1 man-hour of work per house. Actually, site fabrication of houses is an assembly line in reverse. Instead of having the house move on an assembly belt past the workmen, the workers move down the line from house to house.

All the work of building the houses is done by small contractors. Generally speaking, most of these contractors have been skilled workmen who have previously worked in the Levitt organization. Levitt sets them up as contractors and completely finances them, supervises their work, and encourages their progress toward successful operation. There are 26 major contracts for building the house, and most of these are broken down into smaller subcontracts. These contracts make up an incentive system, which is the largest factor in the success of this large-scale building operation. Each contractor or subcontractor has complete responsibility for hiring, paying and supervising the labor for the part of the job he handles. On a total payroll of 3,000 to 4,000 men, only about 10 percent are directly paid by the builder. One of the subcontractors, the carpentry contractor, collects about $40,000 per week.

The subcontractor's price for his job is fixed at the beginning of each season at so much per house. This price is arrived at from two factors — Levitt's estimate of the number of man-hours required for the operation, and the subcontractor's estimate for overhead, which is mostly time keeping, insurance and profit. This price is used experimentally for the first 50 houses, after which it is adjusted up or down and then remains fixed for the duration of the project. This procedure gives the incomparable advantage of fixed cost for the whole building job, while the subcontractor increases his profit as he increases his efficiency.

All subcontractors are closely checked for quality of work and completion on schedule. The rate of pay is computed on the basis of a minimum daily output. For example, Levitt figures that it should take a crew of four men not more than 15 hours to frame a house, and this figure fixes the minimum daily earnings, which are about the same as union hourly scales. Practically all workers do much better than those minimum quotas. Workmen are divided into crews according to skill, and the more skilled groups have a higher basic rate of pay.

The incentive system ensures that each workman will meet his part of the schedule with a minimum of costly supervision while receiving fair wages. It also maintains an open shop and eliminates union regulations and jurisdictional strikes and other work stoppages which could cost millions on a large-scale operation. Various crews perform certain items of work, complete their jobs at each house, and move on to the next. There may be 10 or 12 crews doing the same work in order to maintain the schedule.

A few construction items and figures of unusual interest are: Foundation footings dug with a trenching machine at the rate of 30 per day cost about $1.50 per house. Slabs are poured and finished at the rate of 5 man-hours per house, finishing being done by machine. A house is framed in about 50 man-hours; sheathing is done at the rate of 35 man-hours per house; roofing, 16 man-hours; plumbing fixtures installed, 4 man-hours; rough plumbing assembly, 4 man-hours.

On a production job it is obvious that the workmen, like those in a factory, should do the same item of work over and over again and thus become particularly efficient in it, with a consequent reduction in cost. If the men were switched around from one job to another they would become confused and efficiency would drop.

On a mass production job of this sort, one of the most important principles is complete control by the owner-builder. His careful control of all phases of the work ensures no breakdown in the continuous progress which is essential for success.

The Plant Engineer—
Jack of All Trades and Master of Many

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IN THE WORLD of specialization in which we now live, few engineering positions remain which require the use of general engineering knowledge. Although the professional engineer has received basic training in the various fields of engineering, when he enters the outside world he is seldom required to use this broad type of knowledge.

Perhaps the job of city manager in a large metropolis or that of plant engineer for an extensive industrial enterprise more closely approaches this requirement of general knowledge than do most engineering positions. While the city manager is more closely concerned with administration and political affairs, the plant engineer is surrounded by a multitude of technical problems. Yet in many respects the operation of a city is much like that of an industry. In some cases, where large industrial concerns are located within the city limits, practices necessary in the local industry must obviously be taken into account in the setting up of city procedures. Members of city councils sometimes look toward industry, which is frequently represented on the council by a plant engineer, to help establish policies geared to broad engineering requirements.

Highly specialized subjects such as bridge, dam and mining construction are of course rare to the plant engineer, but many subjects considered specialties a few years ago are now commonly seen on his daily agenda. Air conditioning, color harmony, trackage, safety, fire prevention, exhaust systems, prevention of air and stream pollution and the maintenance and operation of highly complicated automatic machinery are now common phases of his work in progressive industrial organizations.

The plant engineer is frequently called upon to review the technical aspects of materials and equipment to be purchased by his company. He must be prepared to exercise his best engineering judgment in the discharge of this part of his responsibility and must be prepared to defend his conclusions.

The plant engineer is continually striving to find methods that will ultimately lower the cost of the finished product. This entails cooperation not only with many other departments in his own organization but also with the entire industrial field. However, his most important job is inside the fence surrounding his own plant.

Often the plant engineer controls two specific divisions—new construction of expanding facilities and maintenance of present facilities. In both divisions he is dependent on his engineering staff, who report to him through their supervisors. The organization chart of the plant engineering department depends on the magnitude of the plant but usually includes representatives of the mechanical, industrial, electrical and civil branches of the profession. Larger organizations may include specialists trained in such fields as air conditioning, heat, and power. Although dependent on his working staff, the plant engineer must himself be able to initiate, carry through, and present to the management problems in all fields of engineering. He must be able to understand such problems fully in order to point out the advantages and disadvantages to be expected from various proposals, which often involve considerable initial cost with the aim of eventual savings.

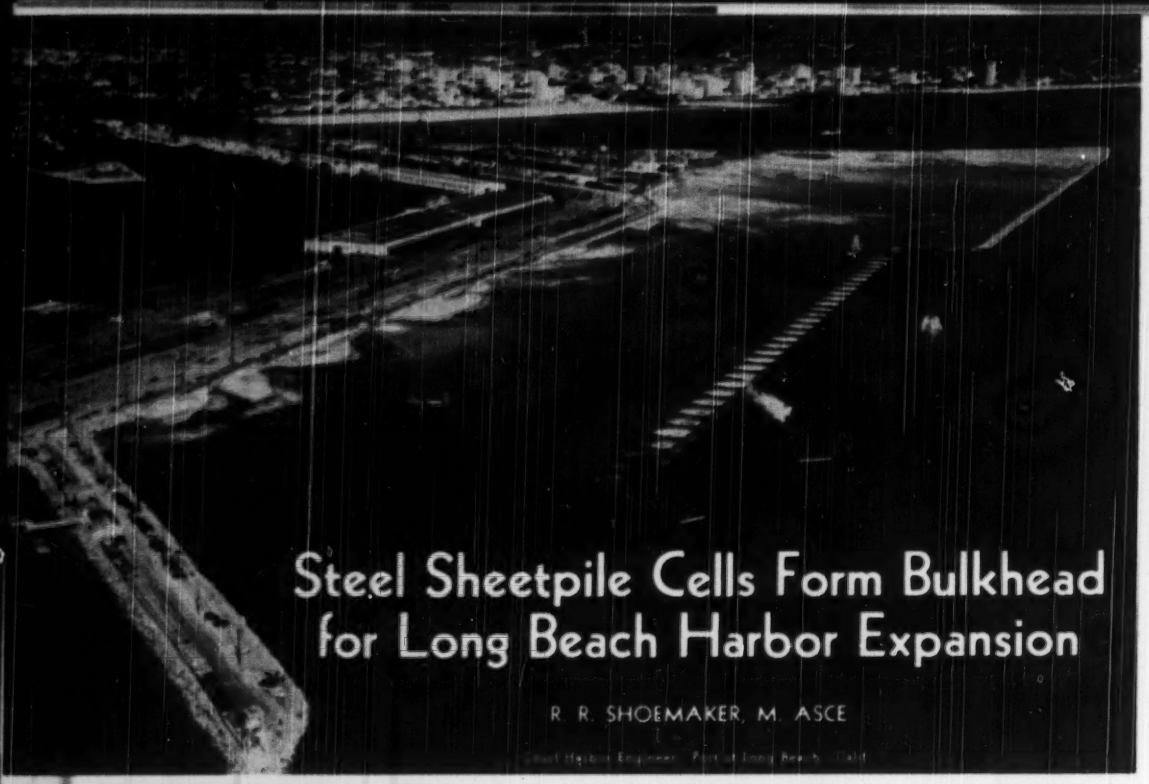
Many Duties Include Labor Relations

The plant engineer is responsible for the construction of new buildings and their facilities, and for the planning of department layouts and changes sometimes involving the installation of millions of dollars worth of machinery. He is responsible for the location of all water lines, sprinkler lines, compressed-air lines, gas lines, storm sewers, sanitary sewers, roads, trackage, lighting and power systems. In truth, he operates a small city. He is the target of many complaints, based on anything from a catastrophic power failure to an unpleasant draft on a stenographer's legs. When key machinery fails, threatening to stop hundreds of workers, it is his responsibility to initiate immediate repairs or, if that is impossible, to provide some makeshift arrangement until permanent repairs can be made.

The plant engineer is also concerned with several phases of industrial and labor relations. He and his staff are often involved in determining the value of suggestions made by other employees. These contributions may be through an established suggestion system or by way of an informal approach to management. In either case employees may be offended or otherwise adversely affected if the plant engineer is clumsy or inept in his relations with the suggestion contributor. It must be realized that investigation and appraisal of suggestions may involve engineering studies of a high and complicated order.

As our knowledge of science and economics expands, the complexities of administration increase. Wage standards and employee incentives become more and more important factors within the scope of the plant engineer's responsibilities. In many modern industrial organizations the general management has provided for additional training for the plant engineer, and others, to help improve his ability to successfully administer new and more complicated procedures. This training usually includes stressing the need for better and more complete understanding of modern concepts and methods concerned with personnel administration. A personal relationship between the department head and the employee under him, an understanding of the personal difficulties of subordinates, and in general greater cooperation between authority and majority are being emphatically stressed by management.

The successful plant engineer must be and usually is in sympathy with this need. He knows that he and his company will benefit by improved human relations and he is anxious to apply the best principles known to his work in this connection. He must always remember that he is an engineer, and an engineer in order to maintain his qualifications to enjoy this professional designation must combine his varied administrative duties with resolution to always provide competent design and sound engineering judgment for his employer.



Steel Sheetpile Cells Form Bulkhead for Long Beach Harbor Expansion

R. R. SHOEMAKER, M. ASCE

Chief Harbor Engineer, Port of Long Beach, Calif.

PERMANANT SHEETPILE circular-cell construction forms 2,780 lin ft of southern boundary of Unit No. 2 Pier A East, largest unit in current Long Beach Harbor improvement program. Pier was completed June 30, 1950, at cost of $4,500,000. Rest of southern boundary of pier is temporary rock dike, which extends for 3,490 lin ft where extensions to pier are planned, and will fill gap which appears in foreground. Enclosed area of 136 acres will be built up with hydraulic fill to create sites for oil wells in immediate future. Circular-cell wall will ultimately serve to meet shipping needs. In distance appears city of Long Beach backed by forest of oil wells.

STEEL SHEETPILING has been put to an unusual use in connection with the harbor development and expansion program of the Port of Long Beach, Calif. Here circular cells of sheetpiling are used to form permanent bulkheads or quay walls at present serving to retain the pier fill but ultimately destined for the berthing of ships in a water depth of 40 ft.

The City of Long Beach is prepared to spend an estimated $100,000,000 on its harbor program, which consists mainly of pier and oil-well construction. Pier fills will be utilized first and foremost as oil-well sites since it is believed that delay in sinking such wells will cause the city to lose huge sums in permanently unrecoverable oil. Parts of the fills can be immediately devoted to Port purposes and later the piers will provide shipping space in accordance with the harbor's long-term expansion program.

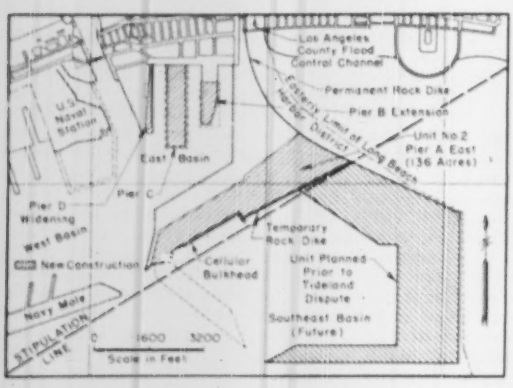
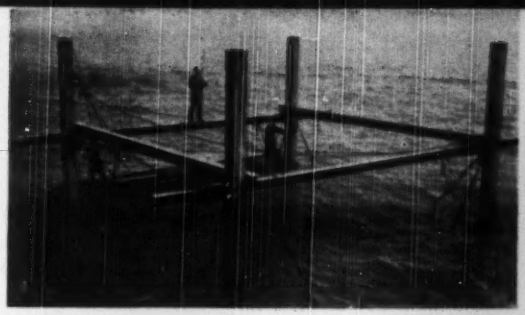


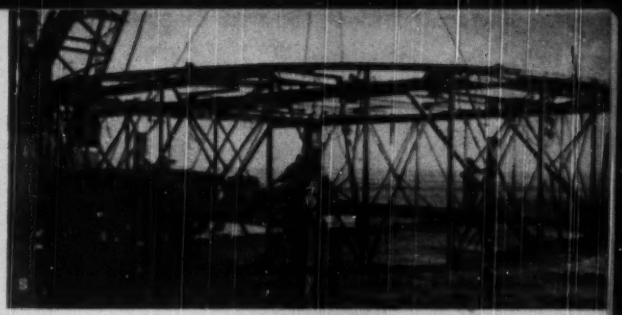
FIG. 1. LONG-RANGE harbor development program of Long Beach, Calif., is estimated to cost more than $100,000,000 when completed. "Stipulation line" shown immediately south of present developments marks boundary set by U.S. Justice Department in tideland dispute. Shoreward of this line local interests hold ownership and seaward of it lie claims of federal government.

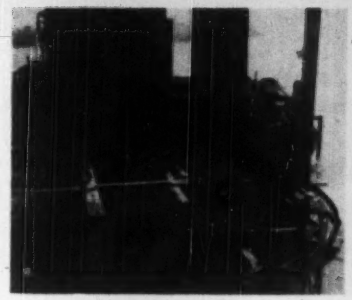
In the early postwar period, the Harbor Commission of Long Beach and its staff exhibited unusual foresight in placing two orders for heavy-section steel sheetpiling. These orders, the largest of their kind on record, have totaled 40,250 tons to date, with a delivered cost of $4,668,550, and are now nearing completion. It is doubtful if the construction objectives of the Port could have been accomplished without this foresight and by any other method than the use of steel sheetpiling.

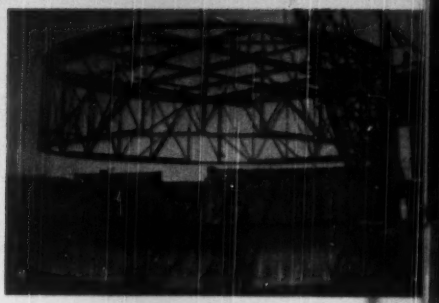
Largest Pier Contains 136 Acres

Several outstanding units of port and oilfield expansion at Long Beach Harbor are representative of the important uses to which the Port is putting this huge stock of steel. The largest, and the one described in this article, is a fill of 136 acres known as Unit No. 2 of Pier A East. Other units are Pier B extension, a new Pier









CIRCULAR-CELL construction involves four main steps: (1) H-piles are driven in square and braced with horizontal struts and supports. (2) Prefabricated cylindrical template is lowered by floating crane over H-piles. Template has height of 14 ft and diameter to just clear piles of 62-ft-dia cell, and is positioned by aid of instruments set up on shore. (3) Sheetpiles are driven between template and outer guard wall, used to aid in proper plumbing of piles. (4) Circular template is lifted out by crane for use in another cell while fill is being pumped in through dredge pipe just visible at left. Four H-piles, shown in (1) above, are also removed for reuse in other circular cells.

C and the bulkheading of Pier D. See map, Fig. 1.

The sheetpiling was purchased through formal public bidding in approximately equal quantities from Bethlehem Pacific Coast Steel Corp. and Columbia Steel Co. The steel sections are rolled at Bethlehem, Pa., at Lackawanna, N.Y., and by Carnegie-Illinois Steel Co. in the Chicago district. Shipments have been made by both rail and water, depending on origin, freight rates at time of delivery and availability of bottoms.

Although some of the piling is only now being used, the Port enjoyed tremendous price advantages by reason of the timing of its orders. Freight rates have advanced 12½ percent during the period of the contracts and the price of the product has advanced about 15 percent. Although the prices have varied throughout the time of the contracts, the Port is estimated to have saved about $785,000, as compared with 1949–1950 prices.

The Port of Long Beach development is the result of an unusual combination of factors. The Port overlies an oil field which has seven producing zones, each requiring a close pattern of oil-well spacing. The adjoining privately owned, oil-bearing uplands are being intensely produced and public tide and submerged lands are subject to drainage from these upland wells. There is a dramatic shortage of drill sites on the tidelands which necessitates the creation of new lands. The primary responsibility of the Port under its tideland grant from the State of California is to develop the submerged lands for harbor purposes.

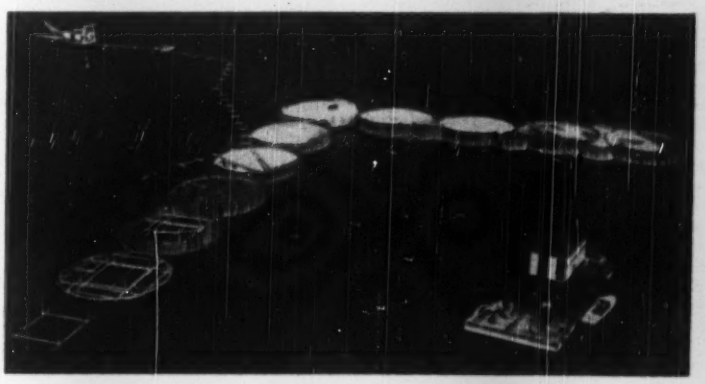
It thus became incumbent upon the Port authorities to comprehensively plan the development of the harbor area so that oil development and operations could be successfully carried out along with harbor development and operations. As a result, a continuous process of comprehensive planning is programmed with a view to creating land masses in the previously submerged areas which will ultimately meet all the basic needs of shipping and at the same time permit proper oil development without interference with shipping.

Race to Conserve Oil Resources

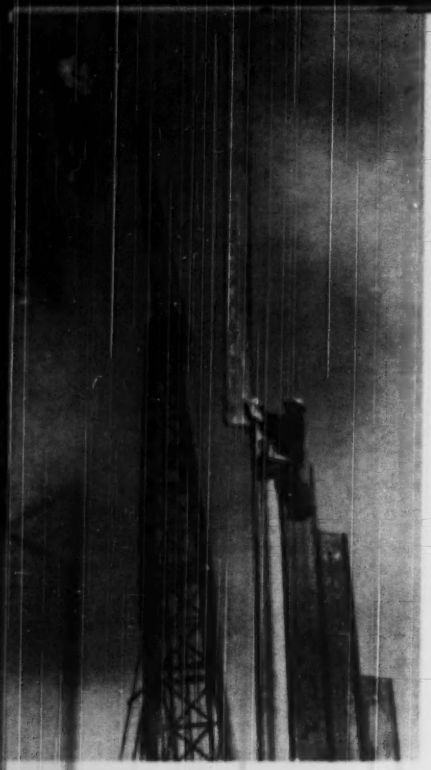
The entire program is a race against time in order that the oil resources may be properly conserved. There have been many physical and legal problems, the latest, most costly, and most restrictive of which are the confusions resulting from the tideland claims of the federal government versus local public bodies.

Several units of the comprehensive plan are currently nearing completion, the largest being Unit No. 2 of Pier A East, an earth fill constructed in water that was originally from 30 to 35 ft deep. This unit is only a small part of the Port's long-range program, estimated to cost upward of $100,000,000.

It has been estimated by petroleum engineers that failure to advance the



FOUR STEPS in cell construction appear clearly in air view. By use of three sets of four supporting H-piles and two templates, all operations are kept moving without delay. Under best conditions, all 156 piles of one cell were set and driven in less than one eight-hour shift. Because of wave and surge conditions, fillets between cells, seen in place at right, were not driven until after circular cells were driven and filled. It was important to fill each cell promptly after driving. Period of about 40 hours was required for filling one cell. Driving of 44 cells in this bulkhead was started in September 1949 and completed in March 1950.



SPECIAL GUIDE CASTING reduces time and hazard in starting sheetpile in position in circular cell. Tongue of last pile placed is slipped into casting, which quickly guides new pile so that its tongue engages groove of pile previously placed.

construction of this unit of fill promptly, so as to provide needed drill sites, might easily cost the public up to $10,000 worth of oil per day in permanently unrecoverable oil.

The unusual shape and dimensions of the project clearly result from the federal versus state tideland dispute which, until congressional action or full adjudication of the differences between the two agencies is completed, will handicap the Port's expansion seaward. Improvements to date in the East Basin and Southeast Basin areas of Long Beach Outer Harbor, are shown in Fig. 1, which also shows a line designated as "stipulation line," immediately south of all existing improvements. Shoreward of this line the U. S. Justice Department stipulated with the State of California that local interests hold ownership, and seaward of it that the federal government's claims lie, without prejudice to the claim of local interests that the line should be farther seaward.

The original orders for steel sheetpiling were placed prior to the Supreme Court decision which resulted in the fixing of the "stipulation line." The materials were ordered for the purpose of constructing units of the proposed port expansion extending far beyond the "stipulation line." The development of the dispute, however, caused a modification of plans, even though at much greater ultimate cost to the Port. As can be seen from Fig. 1, if the circular cells could have been used as originally planned, slight additional work would have made it possible to complete finished terminals along the frontage to have been occupied by the cells, with full protection from the effects of southeast storms. As it is, until such time as the tideland situation is clarified, the frontage occupied by the cells is too exposed to justify a finished terminal.

The several contracts for this unit total approximately $4,500,000, in which the greatest single item is hydraulic dredging. Rock work is a large item, and a sizable part consists of the permanent steel sheetpile quay wall to be used ultimately for the berthing of ships within what will be known as the Southeast Basin, but currently to be used only for retaining the fill.

Unique Construction for Quay Wall

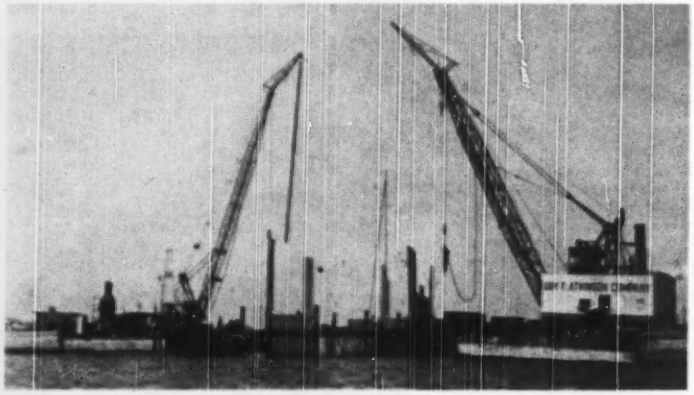
The type of construction chosen for the quay wall is believed to be unique in that it has not previously been used for such a purpose, although it is commonly used for temporary large-scale cofferdam construction. This quay wall is exposed to southeast storms and occasionally to large ground swells originating far offshore, and since the whole project would require nearly a year for completion, it was feared that the construction work would suffer serious damage in the process unless it were unusually rugged. The search for a type of vertical bulkhead wall that could be built unit by unit and stabilized as rapidly as it was placed led to the choice of the filled circular cell, and experience has indicated the wisdom of this choice.

The permanent quay wall or bulkhead construction consists of 44 steel cells, each cell consisting of a total of 156 sheetpiles, of which 36 on the seaward side have a web thickness of $\frac{1}{2}$ in., and 118 on the filled sides have a web thickness of $\frac{5}{8}$ in. Two piles are $\frac{1}{2}$-in.-thick T-sections to provide for the joining of fillets. The 44 cells required 10,540 net tons of sheetpiling.

Variable lengths of piling are used and are driven to different elevations to fit the final design. Maximum lengths are 76 ft and minimum lengths 69 ft. The ultimate water depth along the quay is to be 40 ft. Each cell is approximately 62 ft in diameter, and cells are spaced 65.63 ft center to center, so located as to place the cells and connecting fillets essentially tangent to the pierhead line. The seaward sides of the cells are interconnected by fillets, each consisting of twenty-four $\frac{1}{2}$-in. web sheetpiles joining the cells together through the medium of the special T-sections. Interlocks in all piles are guaranteed to carry 8,000 lb per lin in. in tension, which is important in view of the large tangential stresses in the cells.

The limited choice of steel sheetpile sections available in years past has discouraged the use of circular

TWO DERRICK BARGES speed construction of sheetpile cells. Derrick on left swings pile into position while derrick on right suspends hammer preparatory to driving. Entire operation of lifting pile and putting it in position for driving requires only two or three minutes. Contractor, Guy F. Atkinson Co., developed this rapid method so that partially completed cell would be exposed to surge and storm conditions for shortest possible time.

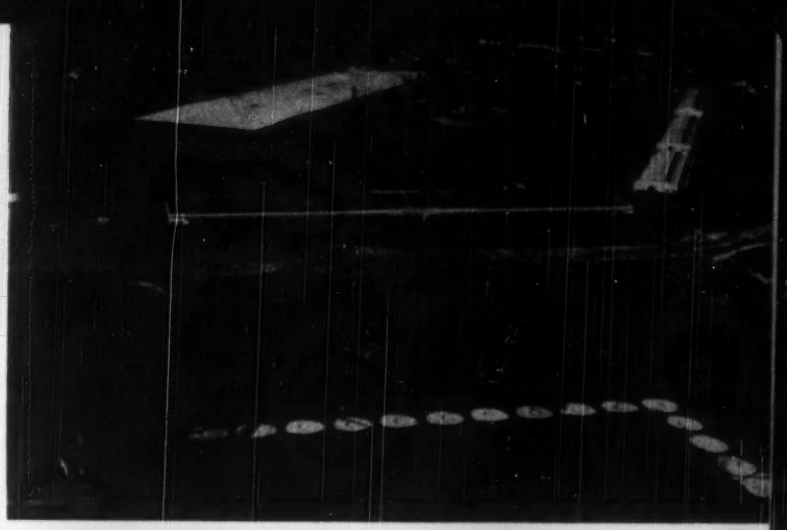


cells in permanent construction because of the distortions that were often experienced. Most available sections heretofore have been rolled to produce a high lateral section modulus, and a change in shape of both the unit piles and the cells was inevitable as the cells were placed under high tangential stress. Each of the major steel companies recently commenced producing a straight web pile designed for use in a true circular cell with little deviation of the line of stress from the center of axis of the sheetpile section and the center line of the interlock connections. Thus the interlocks can be highly stressed with relatively slight deflections, and the cells can be used to form a permanent quay wall.

This type of construction is unusually adaptable to varying water depths and soil conditions, inasmuch as requirements for increased stability can be met both by increased lengths of sheetpiling and by increased diameter of the cells without great reduction in economy of the quay wall section. The circular-cell bulkhead can be completed at any future date by simply pouring a continuous flat slab of reinforced concrete over the front 11 ft of the circular cells, the slab to be continuous with a low retaining wall along the face parallel to the pierhead line. By placing an earth fill over the slab and against the wall and then adding a fender system secured to the front wall and to the harbor bottom adjacent to the circular cells, a finished quay wall results, with strength and water depth sufficient to accommodate any ship afloat or any vertical load desired. The operating surface or quay deck can be developed with various arrangements and kinds of tracks, ballast, subgrade material, pavement and buildings.

The construction lends itself to the building of any type of superstructure in the future since such a superstructure if heavy can be carried on piles independently of and without interference from the quay-wall construction itself. It was at first thought that the cost of this type of construction might prove excessive and would only be justified by reason of construction convenience in exposed areas, but the Guy F. Atkinson Co., contractors for the driving of the steel sheetpiling, have developed a system of handling and driving the cells which results in great economy in the driving costs and seems to enlarge the scope of use.

The 136-acre project included a contract with Pacific Dredging Co. and Franks Dredging Co. which will amount upon completion to about



MAIN HYDRAULIC FILL advances from rear of pier forward. Dredge, several hundred feet to rear of bulkhead (out of picture at right), had to operate at unusual depths, up to 80 ft, because of area limitations imposed by tideland dispute. Small dredge (in center) is used only to fill sheetpile cells. Long Beach Harbor program also includes widening of Pier D (extreme left background), construction of Pier C (center background), and extension of Pier B (right background).

$1,800,000; one with Connolly-Case-Kiewit for rock work in the amount of $393,858; a third contract with the Livingston Truck and Materials Co. in the estimated total amount of $669,000 for rock dike work; and a fourth contract with Guy F. Atkinson Co. of Long Beach in the amount of $448,676 for driving the steel sheetpiles in the 44 circular cells. The value of the steel sheetpiles used in the construction was $1,219,534.

Sheetpiling Meets Other Needs

Not only did the immense orders for steel sheetpiling take care of this Unit No. 2 project, but they also met the urgent needs of the Port for the extension of Pier B, development of Pier C, and widening of Pier D, all of which will ultimately be of great value to the Port for harbor purposes but which are of immediate importance in developing the oil field in an orderly manner and protecting some of the lower areas against high tides—the result of the subsidence phenomenon in the harbor district. Piers B and C required 11,073 tons of Z-section piling with some 1,400 tons of accessories. Pier D required 9,238 tons of piling and 200 tons of steel accessories. The three units added 52 acres of new land (Fig. 1).

The outer ends of both Pier B and Pier C will be the sites of approximately 160 oil wells which will be slant drilled in all directions beneath the adjoining harbor waters to bottom hole locations otherwise out of reach. Future use will include at least 12 ship berths.

After completion of these four projects, stocks of steel piling will remain for carrying on further dike and fill work related to the subsidence problem and to the oil-field expansion program.

Template Facilitates Cell Construction

It was apparent from the first that the construction of the circular cells in exposed waters would call for a portable template to hold the piles in position laterally and vertically during the driving period, and until the cell could be stabilized with sand fill. While methods of forming and plumbing the piles of circular cells have taken many forms in connection with cofferdam construction elsewhere, the necessity for close positioning of each cell in this installation required unusual care by the contractor, and at the same time competitive bidding demanded economy. The method of cell construction decided on by the contractor is illustrated in a group of accompanying photographs.

As it was important to fill each cell promptly after driving, a small hydraulic dredge belonging to Newport Dredging Company, and capable of pumping approximately 100 cu yd per hour, pumped clean, sharp sand into the cells. This required a total of approximately 40 hours per unit.

The dredging work for the general hydraulic fill was done at unusual depths due to the areal limitations imposed by the tideland dispute, inasmuch as the Port was denied the right of removing the sand from the ocean bottom in areas outside the "stipulation line," claimed by the federal government. For depths in excess of 55 ft and up to 80 ft below

(*Continued on page 85*)

Volcanic Clinkers Stabilize Fills on Hawaiian Highway

R. M. BELT, M. ASCE
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DEEP DEPOSITS of volcanic ash, saturated by almost continuous rainfall, proved major problem to builders of Hawaii's Hamakua Coast Highway. Soil samples have shown water-content ratios up to 200. Although fitted with extra-wide treads, equipment bogged down in soupy soil.

SATURATED volcanic ash, ideal for the growing of sugar cane, proved to be anything but ideal for the builders of Hawaii's Hamakua Coast Highway. In this soil, which had the consistency of axle grease, trucks and draglines were unable to place fills until selected borrow of volcanic clinker material was employed to stabilize the embankments.

Extending for a length of 40 miles along the rugged, rain-soaked coast line of the island of Hawaii (Fig. 1), the new highway is estimated to cost $13,000,000. The many deep gulches require a total of 44 bridges, with a maximum length of 772 ft and a maximum height 192 ft.

To date 14 miles of highway and six bridges have been completed in five contracts. Four major bridges and a 4-mile section of highway are currently under construction. At least six more segments, involving 9 miles of highway and eight bridges, will be under contract by the end of 1950 at an estimated cost of $3,557,000. Work completed and now under contract will total $5,560,000, leaving 13 miles of highway with 23 bridges still to be contracted for after 1950 at an estimated cost of $3,883,000. It is expected that all of this will be under contract in 1951.

Prior to the tidal wave of 1946, all sugar, fertilizer and other large freight items for the Hamakua Coast were transported by the Hawaii Consolidated Railway Co., since automobile and truck traffic was limited by a narrow, tortuous road that wound in and out of the deep gulches that abound along the coast. The tidal wave, by tearing out two major bridges, the Hilo depot, and a great deal of track, administered the coup de grace to a railroad that was already in difficulties, and the stockholders, faced with a doubtful alternative, voted for dissolution. This action immediately put the whole transportation burden on the inadequate highway, adding to the established passenger-car traffic an annual sugar haul of 170,000 tons, as well as bagasse, molasses, fertilizer and all the general freight items handled through the port of Hilo.

The county road, with an average width of 16 ft and a total of 12,500 deg of curvature in its 40-mile length, required an average driving time of 3 hours for trucks and 1½ hours for passenger cars. The 3.75 miles completed under the contract with the George Pollock Co. of Sacramento eliminated some of the worst curvature. The total was 62 deg compared to the former 1,782 deg and has already reduced the driving times by 8 and 16 minutes, respectively. The completed highway will reduce driving time by 50 percent.

The project is financed through a special federal appropriation for seismic-wave damage relief which is matched by a special territorial bond issue, and an additional $1,000,000 of regular federal-aid and territorial fuel-tax money. Work is under the direction of the Territorial Highway Department in cooperation with the U. S. Bureau of Public Roads.

Project Engineer E. F. Morrison, Assoc. M. ASCE, and a crew started construction of the first 5 miles and location survey work, from scratch, on the rest of the 40-mile route in the summer of 1947. The heavy rainfall of the area—averaging 145 in. a year—together with the dense tropical foliage in the deep gulches, thick sugar cane on the ridges and a terrain that makes the Dakota Badlands look like a bowling green, all combined to frustrate and plague the location parties.

It was soon apparent that different location techniques had to be used and a contract was signed with Towill & Austin of Honolulu for a photogrammetric survey of the last 30 miles of the line. It takes only one clear day to get many miles of aerial photography, but on the Hamakua coast one clear day is the exception rather than the rule. Even though the final location and cross sections had to be taken on the ground, the final line was selected from the aerial

FIG. 1. HAMAKUA Coast Highway extends for 40 miles northwest from Hilo along coast of island of Hawaii.

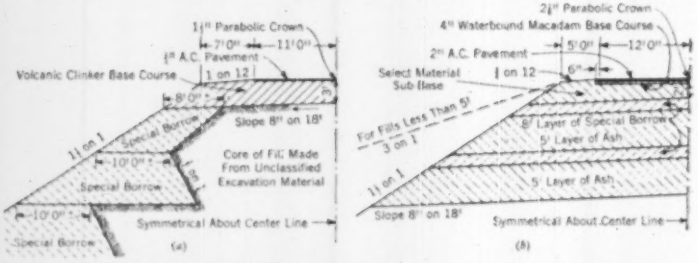
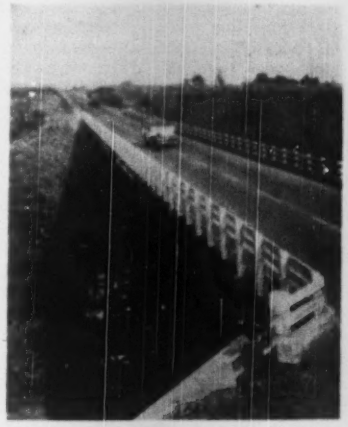


FIG. 2. TYPICAL ROAD SECTIONS illustrate use of selected volcanic clinker of lava material in stabilizing deep fills. System was adopted after draglines and dump trucks became bogged down in fully saturated volcanic-ash soil.

TRAFFIC ROLLS over new coastal highway (above) replacing old road which was inadequate for increased freight traffic resulting from destruction by tidal wave of only available rail transportation. Trucks previously required three hours to traverse 40 miles of road; new highway will halve this time.

WATERBOUND MACADAM base course (above) is rolled along strip of Hamakua Coast Highway. In natural state, soil stands on steep slopes, but once disturbed, its structure collapses.



DEEP GULCHES along coast necessitate construction of 44 bridges within 40 miles of highway. Territorial government purchased five abandoned railroad bridges and will use them in place to carry highway. Bridges are being widened with material from other cannibalized railway bridges. Use of old structures saved estimated $330,000.

contour maps and many false starts and many man-hours of unnecessary work were thus avoided.

The area is covered by a deep deposit of fine volcanic ash saturated by the voluminous rainfall, producing soil conditions that at times have seemed impossible to handle. The very qualities that make it ideal for the growth of sugar cane make it a headache for engineers and contractors. Natural samples have been found to contain twice as much water as soil by weight, that is, a water content ratio of 200 percent when tested. This is optimum moisture content with a vengence.

In its natural state this soil will stand on vertical slopes, but when disturbed it takes on the consistency of axle grease, and equipment bogs down in both cuts and fills. The original road and railroad, built in the days of hand labor and mule-drawn scrapers, escaped the difficulties encountered with present construction methods and equipment. On one section of the project, equipment bogged down in both cuts and fills even after tread widths had been increased on all equipment.

Fills up to 5 ft high could be handled, but in deeper fills, every attempt at mechanical compaction only made the soil softer. End dumping was permitted after tests showed that a better degree of compaction was achieved in this manner, but great difficulty was encountered in getting the fill out of the trucks because of its adhesive qualities.

The contractor next tried a $2^1/_2$-cu yd drag bucket, which proved satisfactory for moving the fill, but which churned up the soil to such an extent that the fills were soupier than ever.

The final solution for the embankments on this project was the liberal use of select volcanic clinker material for toe fills and a 3-ft blanket, Fig. 2 (*a*). For subsequent contracts, a method of alternate 5-ft lifts and blankets of select volcanic material—lava or clinker—is being used, Fig. 2 (*b*). As of this writing, many high fills on the two Glover contracts have been put in by this method with every evidence of success. Careful records will be kept of any settlement of either type of fill.

In handling its contracts, J. W. Glover Ltd., of Honolulu and Hilo, also made liberal use of selected material for access roadways for equipment. Draglines always worked from a solid footing of select clinker material and truck beds were lubricated with sand between loads to facilitate dumping.

In the federal act providing for part of the financing, the stipulation was made that no funds authorized by the act could be used for purchase of any of the former railroad property. Even with this provision, it has been found to be economically desirable for the Territory to use its own funds for the purchase of five railway bridges in place and several more bridges to cannibalize parts to widen the five in place. The total saving, after allowing for 30-year maintenance, is estimated at $330,000. The method used for rebuilding these bridges, which was worked out by Bridge Engineer William R. Bartels, M. ASCE, involved adding two lines of girders (from other old bridges) with the required supports. Girder steel from some of the canibalized bridges is also to be used in the construction of new bridges along the route. Three of these new bridges have been designed by the Bridge Design Division, Western Headquarters, Bureau of Public Roads.

Tidal Wave Protection for Bridges

The Wailuku River Bridge in Hilo, now under construction by the M. G. Sheik Co. of Honolulu, has many tidal-wave protection features. Provision for vertical uplift is made by heavy steel bars anchored to a steel grid and buried in the heavy concrete piers. Horizontal forces are taken up by heavy, short steel columns, against the tops of which are struts connected to the girders. An open-grid steel deck was selected to minimize possible uplift from a tidal wave.

The new highway is designed for a speed of 60 mph, with 4-percent maximum grades, except for a few sections of restricted grade and alignment, where the design speed is 45 mph. General design is for two 12-ft lanes with 5 or 7-ft shoulders. Provision has been made in and near Hilo for future expansion to a four-lane divided type.

Frank S. Carlson is District Engineer for the Hawaii District, U. S. Bureau of Public Roads. The contractors are Jas. W. Glover Ltd., George Pollock Co., M. G. Sheik, and Honolulu Builders Ltd.

Construction Plant at Mount Morris Dam Organized to Meet Rigid Specifications

W. V. GREELEY, M. ASCE

Project Manager, Mount Morris Dam Builders, Mount Morris, N.Y.

FIVE EXPERIENCED CONTRACTORS are jointly building a $20,000,000 flood control dam on the Genesee River at Mount Morris, N.Y. Although the structure is only seventh largest east of the Mississippi River, exacting Corps of Engineers specifications and absence of acceptable natural aggregate at the site complicated construction. One of the prime problems faced by the co-builders was organization of the construction plant to assure efficient use of the vast amount of construction equipment required. (For an interesting comparison of construction requirements here and in Canada see the article by Gordon Mitchell and R. B. Young in the August issue.)

The foundation of Mount Morris Dam, which is located in a 300-ft-deep canyon of the Genesee River, rests on an 18-in. seam of Genundewa limestone overlying Genesee shale. Above the foundation line, the formations consist of the West River, Middlesex, Rhinestreet, and Casaqua shales.

The dam is a concrete gravity-type structure 250 ft high with a crest length of 1,026 ft at deck level. Below the dam an apron section, flanked by stepped training walls 55 ft high, extends 240 ft downstream. The flow of water from the reservoir will be controlled by nine 5×7-ft sluice gates in the dam structure. In the north abutment two openings 20 ft in diameter are provided for future penstock installation. A concrete curtain wall 6 ft wide extends into the abutments of the dam foundations. Varying in depth from 40 to 100 ft, the curtain wall contains a gallery from which the dam foundation will be drilled and grouted.

The work, which started in March 1948, consisted principally of providing access roads to the river bottom, clearing the job site, erecting shops and installing utilities, excavating the abutments and constructing the first-stage cofferdam, and later procuring and erecting the aggregate and mixing plants and the cableways. The first concrete was placed on April 27, 1949.

Raw water for construction purposes is pumped from the Genesee River by two electric-driven Peerless turbine pumps, rated to deliver 1,000 gpm at a 470-ft head, to a 225,000-gal, steel water tank through two 6-in. lines. Electric power is supplied by the Rochester Gas & Electric Company. A suitable distribution system assures adequate water at the various points of use. Treated drinking water is obtained from a main located near the job.

The central compressed-air plant consists of two 21×13×14-in. Gardner-Denver air compressors, each driven by a 250-hp synchronous motor, and one 19×11½×12-in. Gardner - Denver air compressor driven by a 200-hp synchronous motor. These provide a total of 3,650 cfm of air, which has been adequate for the job. Air at all needed points is supplied by 4- and 6-in. distribution lines and 4×12-ft air receivers. A Morely No. 502 Aquatower is set up in conjunction with the main air plant. For remote work, two Ingersoll-Rand HK-500 portable air compressors are used. A fully equipped grease and fuel truck services all trucks, tractors, and shovels.

A rather completely equipped machine shop, built in the early stage of the job, assures proper maintenance of plant and equipment. The main equipment in this shop includes:

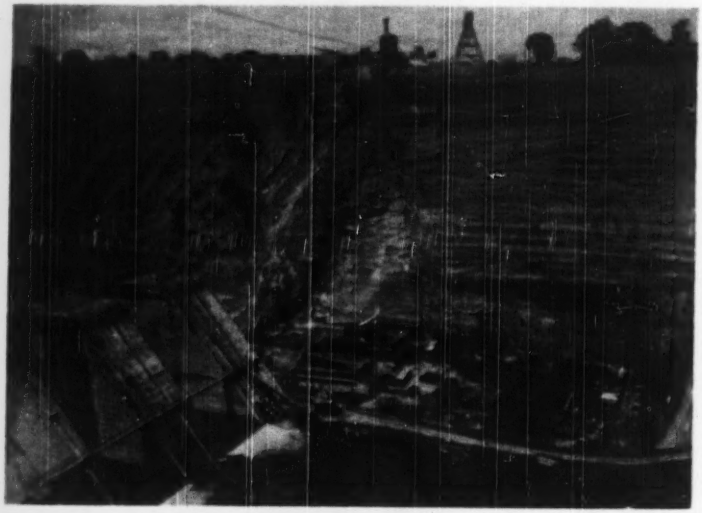
- Buffalo Bench Drill No. 18
- Monarch Lathe, 20×48-in., Model G
- Hamilton Lathe, 8-ft bed
- Kent-Owens Hand Milling Machine No. 2 Horizontal
- Oster Portable Pipe Machine No. 502
- American Radial Drill
- Johnson Metal Band Saw
- Hammond Floor-Type Grinder
- "JO" DeLuxe Steam Jenny
- Rodgers Hydraulic Press
- Ingersoll-Rand Grinder
- Electric Hoist and Bridge Crane—5-ton capacity
- Oster Rotary Pipe-Threading Machine

The carpenter shop is equipped with:

- Red Star Multiplex Saw 50A
- C H&E Saw Table No. 32
- 6-in. Jointer
- Bolt and Disk Surfacer
- 36-in. Crescent Band Saw
- Walker-Turner Jig Saw

Dredge Proves Impractical

Shovels, draglines, and trucks were the principal excavating equipment. A 10-in. dredge, put on the job in the



WATERS OF GENESEE RIVER ARE DIVERTED over two low blocks of Mount Morris Dam as work proceeds in second-stage cofferdam. Part of Corps of Engineers flood control program, concrete gravity structure will cost $20,204,200. Completion is expected in June 1952.

early days of excavation, was abandoned when the river-bed material was found to contain too much oversize gravel for its capacity. The abutments downstream from the dam were stripped of all loose material with D-8 tractors, using angledozers which scaled and pushed the material down the bank, where it was loaded on trucks and hauled to the spoil area. Wet material in the cofferdams was removed with draglines, until pumping operations made the shale foundation accessible to the shovels.

Drilling and shooting of the shale rock was not too difficult. The greatest portion of the drilling was performed with jackhammers. Drilling speeds averaged about 2 ft per min. It required about $^3/_4$ lb of 40-percent dynamite per cubic yard to shoot the rock, with larger unit quantities used in shallow shots.

The main equipment used for excavation, drilling, and other related work was:

1 Link-Belt Speed Shovel, K 580, $2^1/_2$-yd capacity
1 Bucyrus-Erie Shovel 54B, $2^1/_2$-yd capacity
1 Thew Moto Crane
1 Lorain 20 Shovel, $^1/_2$-yd capacity
1 Koehring 605 Shovel, $1^1/_2$-yd capacity
1 D7 Caterpillar Tractor
5 D8 Caterpillar Tractors
1 Caterpillar Motor Grader
1 Hyster D8 Tractor Yarder
1 LeTourneau Rooter
6 Euclid End-Dump Trucks
3 Ford Dump Trucks
1 Ingersoll-Rand J-50 Jackhammer
1 Ingersoll-Rand Stopehammer
1 Ingersoll-Rand Wagon Drill

First-Stage Cofferdam Re-Used

The cofferdam for the first stage, which was constructed on the right side of the gorge, enclosed approximately one-half of the work. In the fall of 1949, it was removed and reused for enclosing the other half of the work.

The cofferdams are the conventional circular cells with connecting arcs. The cells have a diameter of 47.75 ft and are placed 53.35 ft center to center. Bethlehem sheet steel piling sections SP6a, 15 in. wide, 35 lb per lin ft, were employed in the cofferdam. Because of the condition of the steel market, the Corps of Engineers had previously purchased the piling required, and made it available as free government issue.

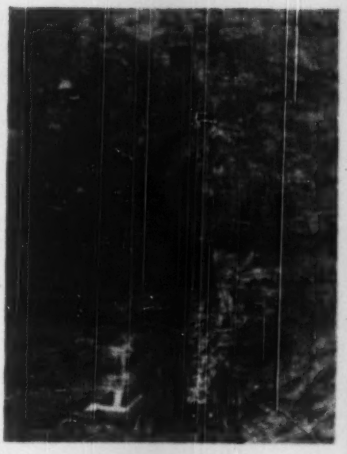
The first-stage cofferdam was built to El. 604 at the upstream arm and El. 596 at the downstream arm and the second-stage cofferdam to Els. 605 and 590, respectively.

The first-stage diversion channel had a capacity of 30,000 cfs at minimum section, and during the second stage the diversion capacity specified was 15,000 cfs. The contractor, however, raised the lower cofferdam arm to provide 24,000-cfs capacity. During the second-stage construction the river was passed through two low blocks in the structure. The second-stage cofferdam was voluntarily flooded in March 1950 during a flood of some 28,000 cfs. A week later, after the work area had been pumped out and operations resumed, a second flood of only slightly less magnitude occurred, but this time flooding of the cofferdam was not necessary.

The twenty cells in the first-stage cofferdam required approximately 2,800 tons of sheetpiling, varying in length from 30 to 49 ft. The second-stage 16-cell cofferdam is tied into the existing masonry by a timber crib. The sheetpiling was driven through varying amounts of overburden, the maximum being about 20 ft. River material was used for the cofferdam fill. The cofferdams were built by erecting an earth dike along the line of the cofferdam to permit the use of land equipment in driving the sheetpiling. A circular templet constructed of 2- and 3-in. pipe and consisting principally of two circular sections 15 ft high was used to shape the cells. The two shovels, equipped with 110-ft crane booms and McKiernan-Terry 9B-3 hammers, drove the sheetpiles. A McKiernan-Terry E4 and Vulcan 800 extractor were used for removing the first-stage piling. One of the cableways supplemented the cranes in this operation.

The specifications dictated that fine and coarse aggregates be manufactured at the site of the work, but permitted primary crushing operations at the quarry site. The contractor preferred to have all operations done at the quarry site, but was unsuccessful in getting this provision of the specifications waived.

The specifications required four sizes of coarse aggregate—6 to 3 in., 3 to $1^1/_2$ in., $1^1/_2$ to $^3/_4$ in., and $^3/_4$ to No. 4. The fine aggregate required is a well-graded sand obtained either by the processing of natural sand or by the production of a suitably graded manufactured sand (see Table I). Natural sand of suitable properties, it was found, is almost non-existent in the Mount Morris Dam area.



EXCAVATION FOR CUTOFF WALL in south abutment is accomplished by shrink stopping method. Tunnel is drilled in shale wall at river level to depth of wall. Top of tunnel is then drilled and blasted. Drilling equipment next moves in over muck, and top of excavation is again drilled and blown. Excavation proceeds in this manner until cut is about 50 ft high. When all muck is removed and excavation filled with concrete to within 7 or 8 ft of top, process is repeated. Because rock volume increases during blasting some muck must be removed as excavation progresses to leave sufficient room at top of pile for movement of excavating equipment.

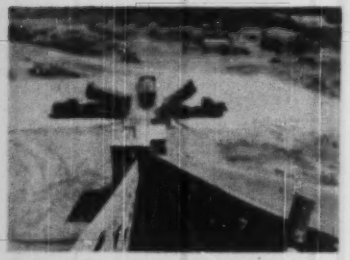
Quarry 26 Miles from Job Site

Aggregate was furnished under subcontract, by the General Crushed Stone Co., of LeRoy, N. Y. Dirt and considerable cherty material is scalped out by a $^3/_4$-in. screen. The LeRoy quarry is located about 26 miles from the job site, and all hauling is subcontracted to B. R. DeWitt, Inc., of Pavilion, N.Y. The aggregate plant, erected especially for the job, consists essentially of a 48×60-ft jaw crusher, a 20-in. gyratory crusher, a 6-ft-dia×12-ft-long DD (double-deck) scalping screen, a 5-ft-dia×12-ft-long DD scalping screen and a series of conveyors and storage facilities.

Material from the jaw crusher is conveyed by a 48-in.-wide belt. The product from the gyratory crusher as well as the throughs from the screens are taken by a 42-in. belt conveyor to the final storage. The oversize on a 7-in.-square mesh screen passes to the 20-in. gyratory crusher. Rock is

Table I. Fine Aggregate Gradation Required by Specifications

Sieve Size	Percent by Weight Retained	
	Minimum	Maximum
No. 4	0	5
No. 8	5	15
No. 16	10	20
No. 30	15	25
No. 50	15	25
No. 100	10	20
No. 200	5	10
— 200	3	5

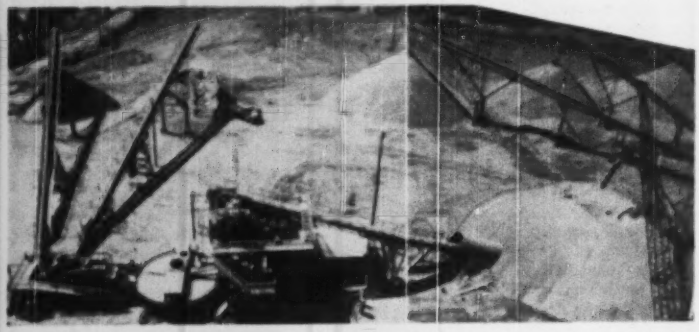


TRUCKS DUMP RAW (3/4 to 7-in.) aggregate from quarry, 26 miles away, into aggregate receiving hopper. Note wide open area provided to avoid congestion in dumping operations. Telsmith apron feeder under hopper feeds aggregate to 36-in. belt which conveys it to 40,000-ton stockpile.

for a round trip is approximately 1 3/4 hours. All stone is weighed at the dam site on a Howe 50-ton truck scale.

The reduction plant at the dam site, designed by the Smith Engineering Works of Milwaukee, incorporates features the contractor thought necessary for a well-balanced plant. The principal features of the plant follow.

A concrete hopper of generous size permits unloading two or three dump trucks at a time. Installed under the hopper, a 48-in.×18-ft Telsmith HD (heavy-duty) apron feeder with a 15-hp Reeves variable speed reducer feeds the first stockpile 36-in. belt conveyor, 198 ft long, which has a capacity of 500 tons per hour, and is driven by a 50-hp motor.



SURGE PILE FOR ROD MILL (at right) is composed of material smaller than 3/8 in. Chimney in core of surge pile prevents segregation and insures uniform feed to rod mill (at left.) Mill feed varies from 60 to 85 tons per hour. Sized aggregates are in stockpiles in right background, and sand is in left background.

SIZED AGGREGATES are discharged from screening plant to separate stockpiles through rock ladders to minimize breakage and prevent segregation. All aggregates are stockpiled over single tunnel 650 ft long and 8 ft in diameter. Gates under stockpiles feed desired aggregates to conveyor in tunnel, and deliver to mixer.

stored over an 18-ft round steel tunnel form, through which trucks pass to be loaded. Approximately 15,000 tons of storage capacity is available.

Rock—3/4 to 7 in.—is hauled to the dam site in 15- to 20-ton dump trucks some of which are equipped with a winch-lift body. The average time

Material is withdrawn from this raw-aggregate stockpile by a 48-in.× 7-ft Telsmith HD plate feeder and a 36-in. belt conveyor through a short section of Armco Multiplate pipe 96 in. in diameter. The capacity of this conveyor, which is 350 tons per hour, determines the capacity of the remainder of the plant.

Material for the 6- to 3-in. aggregate pile is removed by a 5×12-ft DD Telesmith scalping screen and is stockpiled by a 30-in. Barber-Greene stacker belt. This size of aggregate is called cobbles. Rock 6 in. plus in size and any excess cobbles pass through a 16B* Telsmith primary breaker, driven by a 75-hp motor. The product from this crusher as well as the throughs from the scalping screen are conveyed by a 36-in. belt to the central screening plant.

The screening plant, which is located on top of the timber storage bins, consists of four 5-ft×12-in. DD Tyler Tyrock vibrating screens. Of the four compartments in this bin, three release screened materials to their respective sized storage pile—that is, to the 3-in. to 1 1/2-in. pile; 1 1/2-in. to the 3/4-in. pile; and 3/4-in. to the No. 4 pile. The fourth bin feeds back to a No. 48 Telsmith Standard Gyrasphere crusher driven by a 100-hp motor for recrushing excess sizes.

A Symons 4-ft Standard cone crusher was set up adjacent to the Gyrasphere for recrushing the excess of the finer sizes and to provide feed for the rod mill. During the winter season the 4-ft Symons was replaced with a 5 1/2-ft Symons short-head crusher for increased capacity. The products of both of the reduction crushers are recirculated back on the delivery belt, and passed over the screens again. Bypass chutes and gates are provided to send more or less material to the crushers or sized materials to the stackers as may be necessary for balanced operation.

The surge pile for the rod-mill feed is essentially composed of material smaller than 3/8 in., from which sand is manufactured. A chimney is located in the core of the surge pile to prevent segregation and assure a more uniform feed, and also to eliminate the separation of fines caused by the high winds prevalent in this area. Material is withdrawn from the surge pile by a 24×72-in. Jeffrey No. 4HM1 pan feeder and conveyed to a chute feeding each end of the rod mill.

The rod mill, a Marcy 8-ft-dia round×12-ft-long center peripheral discharge, was furnished by the Mine & Smelter Co. of Denver. It is driven by a V-belt-connected, 500-hp, 2,300-v motor, which the contractor had available. The rod-mill product is pumped by a 5-in. Wilfley pump back to two 4 ×12-ft DD Telsmith Vibro-King screens located over the rod mill where the oversize material (No. 4+) is directed back to the mill. Part of the throughs can likewise be diverted to the mill through finger chutes. When operations started, the materials passed directly over the screens, the coarser materials being diverted to the mill, and the fines to the classifier. To obtain greater production and better particle shape, this procedure was later changed, so that all materials passed through the mill, and the mill was speeded up from 14.9 to 17.2 rpm. The initial rod charge, made up of 2, 2 1/2 and 3-in. high-carbon round rods, was approximately 40 tons. Replacements are 3-in. round rods, although some 3 1/2-in. round rods are now being tried. Rod wear approximates 1.25 lb per ton of finished sand.

The fines from the two sand screens are flumed to an 8×39×22-ft-diameter bowl-type Dorr classifier.

This unit consists of a comparatively shallow round tank or bowl superimposed upon a rectangular tank with an inclined bottom. The bowl is equipped with revolving rakes or plows, which convey settled material to a central opening in the bowl bottom where it passes down into the rectangular tank. Reciprocating rakes in the rectangular tank carry the sands up the inclined bottom to be discharged as a drained product. To carry away the slime, the bowl is equipped with an overflow launder, the size of which is controlled by dilution and velocity of flow. The waste material, which is flumed to a settling pond, approximates 12 percent of the total rod-mill feed. Between 600 and 800 gpm of water are required for the sand plant. The finished sand discharged from the classifier is conveyed by one of two belt conveyors for final storage. The specifications require that sand be allowed to drain for 72 hours before using. This provision reduces variations in sand moisture and makes less trouble in operation of the mixing plant.

All sized aggregates are stored over an 8-ft-dia tunnel, which is some 650 ft long and partly buried for stability. The tunnel is made of 10-gage Armco Multiplate pipe except at gate openings, where 5-gage pipe is used. There are four gates under each of the stone piles and ten under the sand pipes. At first, the gates were operated manually, but later the gates under the cobbles and the two other coarser sizes were changed to air-ram operation. The material is taken, one size at a time, on a 30-in. belt conveyor to the central mixing plant. All stone is first put on a 5×12-ft DD Telsmith rinsing screen, where dust and dirt are removed. During the winter a 5×10-ft DD Telsmith screen was added to facilitate dewatering.

All sized stone is discharged from stackers through rock ladders to minimize breakage and segregation as required by specifications. In all, there are 17 belt conveyors in the system, varying in width from 18 to 42 in., operating at speeds of not less than 300 fpm. The general layout of the entire aggregate processing plant is shown in Fig. 1. The concrete mixing plant, made by C. S. Johnson, consists of a 400-cu yd, five-aggregate-compartment Octo Bin with a 400-bbl central cement tank, individual batchers, and three 4-cu yd Koehring front-end discharge concrete mixers. Equipped for automatic operation, the plant has all the modern features required for close control of weighing and mixing. Its operation requires one panel-board

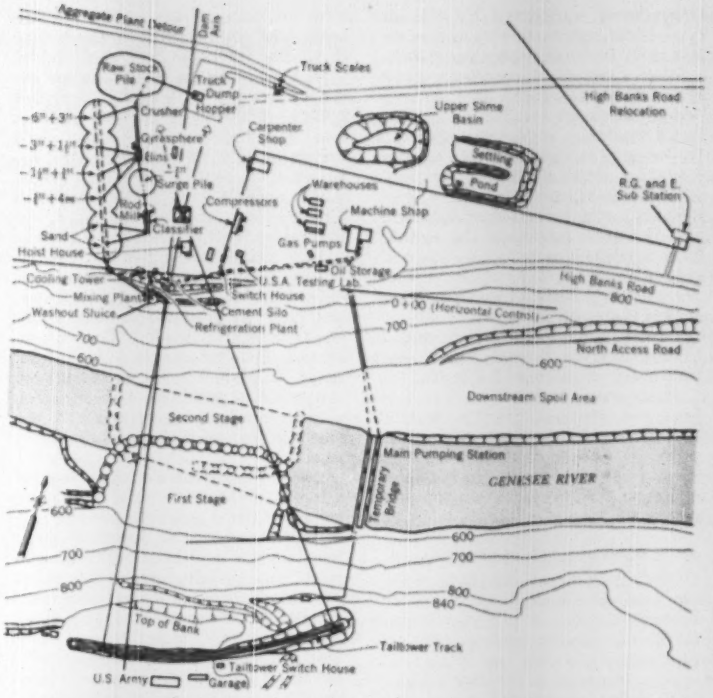
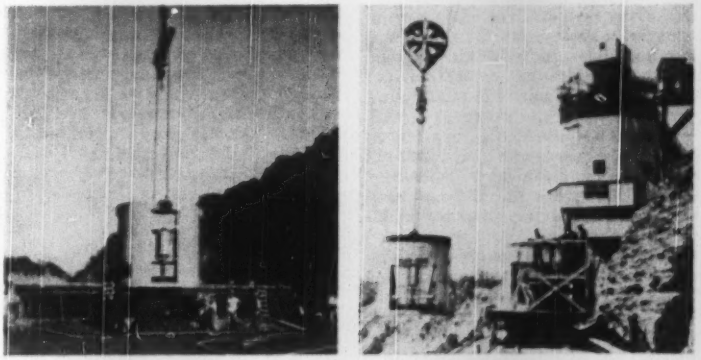


FIG. 1. ALL AGGREGATE is trucked from distant quarry and processed at dam site.



DUAL 8-cu yd bucket (left) is divided into two equal compartments, each with separate discharge to comply with Corps of Engineers specifications. At mixing plant (right) dual bucket is picked up from transfer car by cableway and carried to location of pour in dam.

operator stationed at the turnhead atop the bin structure, who diverts the aggregates to their proper compartments. A man stationed in the reclaiming tunnel keeps the operator informed of the kind of materials wanted.

After the concrete is mixed, it is discharged into a wet-batch hopper under the mixers. Transfer cars, loaded with 8-cu yd dual buckets, receive the concrete from the hopper. Cableways then pick the loaded buckets from the transfer cars, and deliver them to the forms. Where size of forms or other considerations dictate, 2- and 4-cu yd buckets are used. The 8-cu yd dual buckets, manufactured by Gar-Bro and Blaw-Knox, have two compartments, each with a 4-cu yd capacity and separate discharge as specified by the Corps of Engineers.

Concrete is compacted by CP air-type, high-frequency vibrators, of not less than 6,000 impulses per minute.

Blaw-Knox steel cantilever forms are used on the main dam sections. Wood panels are used for the stilling basin, training walls, and galleries. In the early stages of the job, the steel forms for exposed surfaces were lined with Hydron, an absorptive form lining. Later, Hydron was eliminated and the steel forms on the exposed faces were lined with 2-in. tongue-and-groove lumber. The cantilever forms are anchored with Richmond $1^1/_4$-in. anchor bolts and Ty-coils.

Forms are raised by means of Coffing safety-pull ratchet lever chain hoists and aluminum A-frames.

Horizontal construction joints are generally prepared for the next lift of concrete by cutting with an air-water jet, although some sand blasting is employed. Sand for blasting is made on the job with a shop-made rotary sand drier.

Bulk Cement Hauled by Truck

All cement is furnished in bulk from two cement companies, Lehigh and Federal, located in Buffalo. During the first season cement was shipped in railroad hopper cars, but it was found more advantageous for the contractor to have it hauled by truck from Buffalo. This arrangement is working out very well, making for closer control of storage and eliminating the inherent troubles always to be found in unloading railroad cars. The trucks haul from 80 to 120 bbl per trip and make two 126-mile round trips a day.

Cement is unloaded into a 50-ton hopper and conveyed to a 7,300-bbl silo by bucket elevator. The cement is reclaimed from the silo and conveyed to the mixing plant by an inclined screw conveyor.

The specifications require provision of facilities for refrigerating all mixing water to a temperature of 35 deg F. They also stipulate that when concrete is deposited in the forms during warm weather, it shall have a temperature of not more than 70 deg F. To meet these requirements, the contractor installed a Vilter system for cooling water, and a Vogt 30-ton tube-ice machine.

The Vilter equipment includes one water cooling tank 25 ft×10 ft×3 ft 6 in., and six stands of baudelot-type water-cooling coils, each stand 24 pipes high×20 ft long. The baudelot coils, of $1^1/_2$-in. (outside diameter) pipe, will cool 80 gpm of water from 80 to 35 deg F with 27 deg F ammonia evaporating in the coils when 100 gpm of prechilled water is recirculated over the coils. Other items are one horizontal ammonia accumulator; one 50-in.-dia 12-ft-high, vertical, open-type, shell-and-tube ammonia condenser containing 324 two-inch tubes totaling 2,037 sq ft of tube surface; two 8-cylinder compressors, each driven by a 100-hp motor, with a capacity of 80 tons of ice per 24 hours, when operating at 880 rpm with 40-lb suction and 185-lb discharge gage pressures; and one 1,000-gpm Binks natural-draft cooling tower.

The Vogt automatic tube-ice machine has a freezing capacity of 30 tons per hour when supplied with water not exceeding 35 deg F. The freezing cycle for the tube-ice is 10 to 12 min. After freezing, the ice is discharged into an insulated bunker, from which a screw conveyor transports it to the ice batcher located in the mixing plant.

Operation of the ice plant was begun on July 5, 1949. On days when temperature of concrete exceeded 70, it was necessary to purchase ice in Rochester, 35 miles away, to supplement the capacity of the ice plant. A total of 72 tons of ice was purchased during the 1949 season. Ordinarily 100 to 125 lb of ice per 4-cu yd batch was sufficient to keep temperatures below 70 deg F. During the hottest days, this had to be increased to 225 lb per batch.

Concrete is placed by one or two 25-ton cableways spanning 1,710 ft across the gorge, with movable tailtowers and a common headtower. The operating machinery as well as the two tailtowers were transferred to the site from Shasta Dam in California. The cableway is operated by two Lidgerwood three-drum hoists, one powered by a General Electric d-c 500-hp motor generator set and the other by a 500-hp Westinghouse a-c motor located immediately in front of the headtower.

STEEL HEADTOWER, supporting 1,710-ft-span cableways used to transport concrete, is common to two tailtowers. Structure stands 100 ft high. Tailtowers and operating machinery were used at Shasta Dam in California.

The cableway operators are stationed in a cab house at the north rim of the canyon about 200 ft from the hoist house. From this location they have a complete view of the job site, and can follow the travel and hoisting of loads to and from the dam. The cab house is so situated that the operators have full control over the landing and hoisting of the concreting buckets at the concrete transfer track.

Job operations proceed throughout on three 8-hour shifts. Concrete plant production for the average day runs about 2,000 cu yd. It is planned to step up production 3,000 cu yd a day as soon as the sluiceway forms in the dam are covered. Concreting operations will be continued until December 1, 1950, and will start again in March or April 1951, with completion scheduled for December 1951. Plant dismantling, job clean-up, and moving out operations will be done through the winter of 1951–1952 so that the job can be turned over to the Corps of Engineers by June 1952.

The Corps of Engineers, under Col. Frank H. Forney, M. ASCE, of the Buffalo District office, is represented on the job by Resident Engineer J. E. Harns, Assistant Resident Engineer Hugh Kramer, and T. Wheeler, Concrete Technician.

The Mount Morris Dam Builders is a group consisting of five contracting organizations with wide experience in heavy construction and dam building. They are: The Arundel Corp. of Baltimore; the Hunkin-Conkey Construction Co. of Cleveland; Shofner, Gordon & Hinman of Los Angeles; J. C. Maguire of Los Angeles; and L. E. Dixon Company of San Gabriel, Calif.

The Mount Morris Dam Builders are represented by C. W. Black, M. ASCE, of The Arundel Corp., as sponsoring partner; the writer of this paper as project manager; R. E. Martin, M. ASCE, who helped in the preparation of the paper, as chief engineer; and George Bralye, M. ASCE, as assistant chief engineer. The field forces for the contractor are ably supervised by such veteran dam builders as Frank Bryant, S. L. Wixon, L. Freckleton, L. Osborn, L. Pearce and Bert Choate.

(This article is based on the paper presented by Mr. Greeley before the Construction Division at the EIC-ASCE joint meeting in Toronto.)

King-Sized Venturi Measures New York's Water Supply

WALTER J. GRESS, M. ASCE
Senior Designing Engineer, Board of Water Supply, New York, N.Y.

KENSICO RESERVOIR, with a capacity of 30.6 billion gal of water, is New York City's emergency reserve and the secondary distributing reservoir channeling water into city tunnels for distribution. As daily and hourly demands continue to rise, the capacity of the Hillview distributing reservoir will have to be increased, or the problems of distribution must be transferred to Kensico Reservoir. The latter course would entail major modifications in the Hillview outlet chambers and shafts and, most likely, a radical change in the flow-regulating procedure.

In an article on the metering equipment of the Delaware Aqueduct, (CIVIL ENGINEERING, January 1950) the controls and general layouts of the effluent chambers at Rondout and West Branch Reservoirs were described. Among the illustrations was a diagrammatic plan of the high-level systems, both existing and under construction (Fig. 3). An examination of this diagram reveals the important function of the south effluent chamber at Kensico Dam in the combined operation of the water supplies of the city.

The problems of surge and dissipation of excess energy, present at the Rondout and West Branch Reservoir outlet chambers, are absent at the south effluent chamber of Kensico Reservoir. Consequently, it was possible to install a single Venturi meter in the downtake shaft. This tube, with an 18.5-ft entrance and a 12.0-ft throat, has a range of 180 to 2,000 mgd and is believed to be the largest circular Venturi meter in existence.

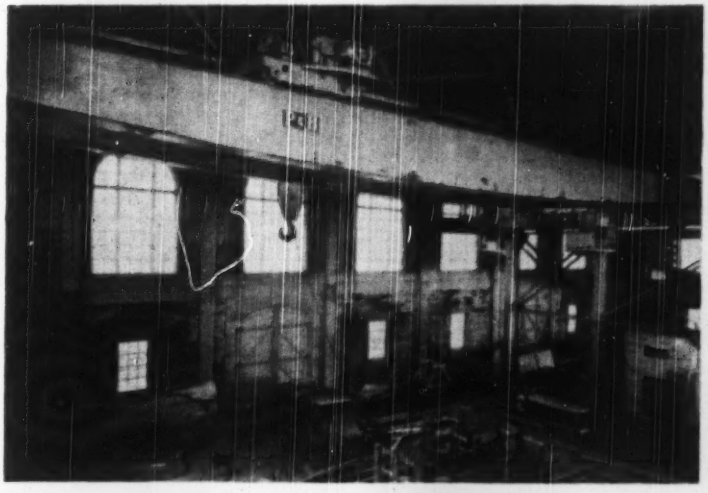
Horizontal and vertical sections through the substructure, including the downtake shaft and aerator, are shown in the accompanying Figs. 1 and 2. There is sufficient depth at Kensico to permit a draft from different levels. The flow from the reservoir to the main forebay enters the chamber through five waterways and progressively passes through trash racks, traveling screens, and 6×15-ft sluice gates. While the Rondout and West Branch chambers have fixed-type screens that must be withdrawn from their grooves for manual cleaning, the Kensico screens are the traveling type furnished by the Link-Belt Co. Said to be the largest screens made, they have panels measuring 2×10 ft and a $\frac{1}{4}$-in. copper wire mesh. To protect these screens from possible damage due to high velocities and rapid clogging, all five reservoir waterway sluice gates are kept fully open regardless of the quantity being delivered through the chamber.

If necessary, the flow from the West Branch or Rondout Reservoir can be diverted directly into the effluent chamber forebay through the respective Kensico and West Branch bypass tunnels and sluice gates. Under this condition of operation the water could be chlorinated at the respective outlet chambers of the series of reservoirs upstream but screened only at the highest intake.

Aerator Covers Three Acres

The Delaware system has only one aerator, which is located adjacent to the Kensico south effluent chamber. This aeration basin covers about three acres and can handle 1,200 mgd. The flow through the effluent chamber is controlled on the downstream side of the forebay. One path to the downtake shaft is by way of the aerator. Ten 5×8-ft sluice gates, located in two rows of five gates in tandem, are operated fully open or closed and distribute the water to the various sections of the aerator. The fractional quantities of the maximum capacity of the chamber are obtained by this method of operation. Each of the gates controls one-tenth of 1,200 mgd. The aerated water is collected in an open channel and directed into a large conduit where it flows over a weir with bronze flap gates, then through five 5×15-ft sluice gates and into the downtake shaft. The latter sluice gates are closed, to prevent back flow into the aerator basin when the direct path of flow between forebay and shaft is used.

An alternate method of control, also shown in Fig. 1, is by three 60-in. conduits with throttling conical plug-valves located in a valve chamber, on either side of which are two 5×15-ft roller-type sluice gates. This arrangement, which is the direct connection to the shaft, can handle the maximum quantity of 1,800 mgd. The 60-in. conduit outlets are located some distance from the center of the shaft and are spread out laterally. The issuing jets, therefore, enter the shaft at a slight angle with its vertical axis. To eliminate turbulent flow and vortex action in the region of the Venturi meter resulting from this situation, straightening vanes have been built into the downtake shaft ahead of the Venturi meter tube.



SHAFT WORK IS HANDLED by mine hoist (at right in photo), its ¾-in. cable passing over sheave on anchored north overhead crane. Cable then passes down through crane girders into shaft in front of truck.

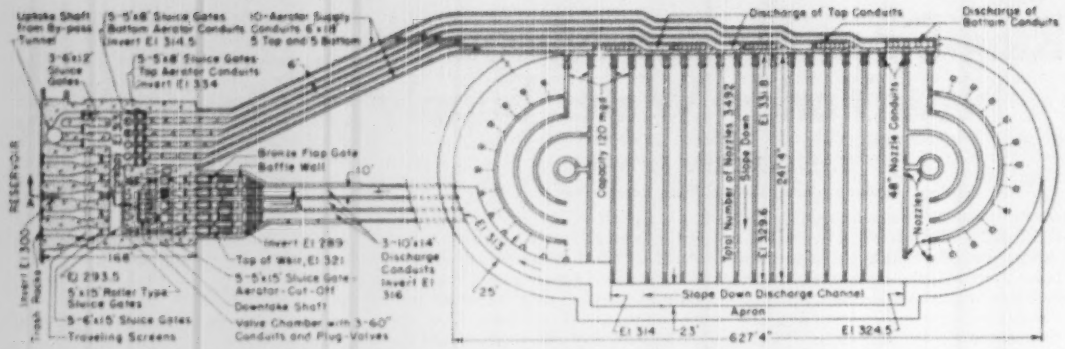


FIG. 1. AERATOR for water from Kensico Reservoir has capacity of 1,200 mgd, covers three-acre area, and connects with Shaft 18 of Delaware Aqueduct, marked "downtake shaft." Complete cost of works shown in Figs. 1 and 2 approaches $6,300,000.

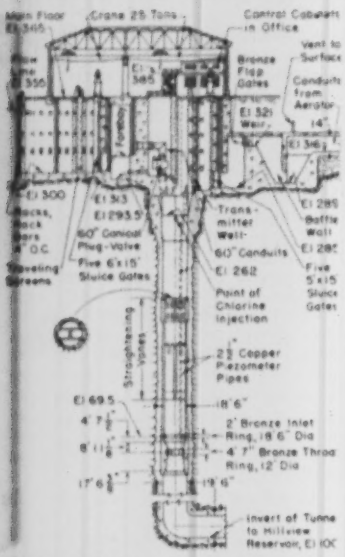

Crane 25 Tons
Control Cabinets in Office
Vent to Surface
Bronze Flap Gates
Conduits from Aerator
Transmitter Well
60" Conduits
Five 5'x15' Sluice Gates
Point of Chlorine Injection
2½" Copper Piezometer Pipes
2' Bronze Inlet Ring, 18'6" Dia
4'7" Bronze Throat Ring, 12' Dia
Invert of Tunnel to Hillview Reservoir, El 100

FIG. 2. SHAFT 18 conducts water from Kensico Reservoir—either raw or aerated—into New York City's distribution tunnel, invert of which is 455 ft below reservoir level. In this shaft is located largest known Venturi meter, with capacity of 180 to 2,000 mgd. Record-size traveling trash screens are installed in inlet works at top of shaft.

The aerator, shafts, and structure at Kensico Dam were completed under an earlier contract just before our involvement in World War II. Provisions were then made in the various parts of the chamber for installation of the operating equipment now being furnished. Thus existing conditions in the shaft determined the location and design of the straightening vanes and Venturi meter. Both the inlet and throat rings of the meter tube are made of six manganese bronze segments, bolted together and aligned by means of tapered pins. The pressure chambers, to which the piezometer pipes connect, are integral parts of the castings. The interior surfaces are ground smooth, and highly finished bronze plates are inserted in the castings at the location of piezometer holes. The transition zone between entrance and throat is ellipsoidal in shape and made of concrete. While the conical tail section, also made of concrete, is shorter than customary in the conventional design, the resulting head losses are small. Copper piezometer pipes, $2^1/_2$ in. in diameter, are located in the shaft lining and extend upward to the transmitter well, where there is a standard MO type Simplex transmitter modified for electrical transmission. The installation includes mercury and water manometers to be used for checking the transmitter over its full range.

Setting Venturi Rings Hazardous

Before the Venturi meter tube could be erected in place in Shaft 18, the emergency flow through the Kensico Hillview Tunnel, which had been started in April 1942, was shut off, and a sinking pump mounted on the cage in Shaft 23 lowered the water to El. +25. The main pumps, for unwatering the tunnel for inspection, also located in Shaft 23, lowered the water below that level during construction work in Shaft 18. During the unwatering period of several weeks, the floor opening in the building over Shaft 18 was enlarged, circular concrete forms were built, a mine hoist was installed in the chamber, and a float consisting of twelve 50-gal drums covered with a light wood platform was lowered to the surface of the water in the shaft.

From the floating platform at El. 25 a heavy working platform consisting of steel I-beams decked with 2-in. plank, was erected at El. 31, supported on 2-in. pins drilled into the old lining.

Forms for the new concrete lining were built in lengths of 7 or 8 ft, each divided into four sections, small enough to pass through the floor opening into the shaft. As concreting progressed, the working platform was raised to new elevations and supported as before.

Aggregates were batched in the Mount Vernon plant of the Colonial Sand and Stone Co. and hauled in mixer-body trucks to the site, where cement and warm or hot water were added. Concrete was dumped into a 1-yd bottom-dump bucket; lowered by the mine hoist into the shaft; and deposited on a wooden platform, from which it was shoveled back of the forms and vibrated into place. Cylinders made from concrete placed in the lining and straightening vanes averaged 5,000 psi in compression after 28 days.

When the pours had reached El. 52.4, preparations were made to set the six segments of the bronze throat section of the Venturi meter. Eighteen steel supports were embedded in the concrete, one for each pad, on which the section was to rest. The segments were lowered, one at a time, onto the support, assembled, and the form faired in from the concrete below to the face of the bronze throat ring; and bolts provided in the supports were adjusted to bring the ring level at the correct elevation. Concrete was then placed behind the ring to 1.5 ft above the bottom of the section and the $2^1/_2$-in. copper piezometer pipe from the collecting ring attached.

Concreting continued to 1.5 ft below the $18^1/_2$-ft-dia entrance ring, or to El. 67. Steel supports were set into the top of the concrete in the same manner as for the lower ring.

MANGANESE BRONZE inlet and throat rings of Venturi meter tube are made of six segments each. Pressure chambers are integral parts of casting. Throat casting (left) weighs 8½ tons, and entrance ring (right) 7½ tons.

Before placing these segments a portion of the old concrete had to be removed to make way for the entrance ring casting. This was done by drilling holes, tipped downward 45 deg, 18 in. deep around the perimeter of the shaft. A short length of the perimeter was shot at a time with light charges of ¼ to ½ sticks of 40-percent dynamite to the hole, so as not to damage the concrete or the working platform. A chase was also cut in the old lining for the two 2½-in. copper piezometer pipes.

Placing the reinforcing steel, placing and testing the piezometer pipes, and setting forms progressed in 8-ft lifts up to El. 189. Reinforcing rods were attached to ¾-in. bolts, held in expansion shields inserted in drilled holes in the old lining, before forms were set.

Construction of Straightening Vanes

Between Els. 102 and 149, and again between Els. 169 and 189, the straightening vanes are located. Keys 32 in. wide were inserted in the new lining at points where it was to be intersected by vanes, and the reinforcing steel to connect the lining and the vanes was left in these spaces to be bent outward later when the vanes were constructed.

In preparation for the construction of the vanes, a frame of 15-in. I-beams was set into the keyways at El. 100 to provide support under each of the vanes. Metal-bound and treated ⅝-in. plywood forms for the vanes were made by the Universal Form Co. Concrete in the vanes was placed in 8-ft lifts, and the last lift was poured late in May 1949. After checking of piezometer pipes and final inspection of the shaft (June 3), water was admitted to the tunnel from Kensico Reservoir.

Frazier-Davis was contractor on the project, which required four months of difficult and hazardous construction. There were no serious accidents. For the Board of Water Supply, John F. Cassidy, M. ASCE, was division engineer; Vincent G. Terenzio, M. ASCE, section engineer; and William A. Nolan, M. ASCE, safety engineer.

Equipment Electrically Operated

The conical plug-valve control cabinet, located in the building over Shaft 18, has a panel reserved for mounting a large flow-indicating dial, a totalizer, a chart recorder, and reservoir and downtake-shaft water-elevation indicators. The electronic control circuit of the flow-indicating instruments is similar to that developed for the Rondout and West Branch Reservoir outlet chambers described in the earlier article.

The 25 sluice gates, 3 conical plug-valves, and 5 traveling screens of the Kensico chamber are operated electrically. With the exception of the valves, the gates and screens are controlled from their respective locations on the main floor.

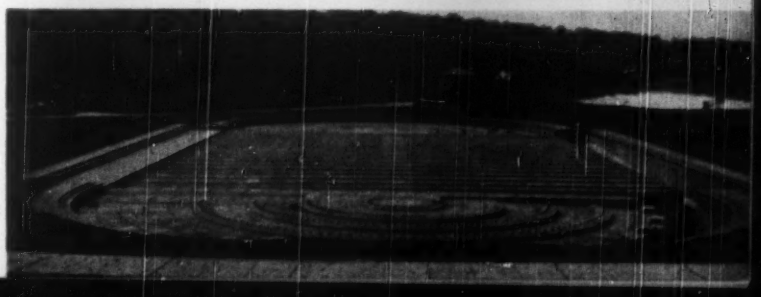
The magnitude of the Kensico South effluent chamber can be appreciated when it is realized that it will control a volume of water one-third greater than the present consumption of New York City. One of the indispensable units in the operation of this chamber will be the shaft Venturi meter supplying a continuous record of dependable and accurate metering information without which the control of such huge amounts of water would be "blind."

The Venturi meter and appurtenant instruments were furnished by the Simplex Valve and Meter Co. As subcontractors, the American Manganese Bronze Co. made the bronze ring Venturi castings, and Gordon Ewertz, consulting engineer, designed and furnished the water level equipment.

The president of the Board of Water Supply is Irving V. A. Huie, M. ASCE, and the chief engineer, John M. Fitzgerald, M. ASCE.

Cost of the total works at Shaft 18 including excavation, shafts, housing, gates, traveling screens, valves, cranes, aerator, meter, piping, and other equipment approaches $6,300,000. The cost of the lining and meter installation was just over $100,000.

NEW KENSICO AERATOR, below and in Fig. 1, will blow reservoir water into air through 3,492 nozzles. Old aerator is seen in operation in right background. Housing over Kensico south effluent chamber and Shaft 18 appears in view at right.



FREE ROAD or TOLL ROAD? This rural expressway built and operated by State of Connecticut is free road with all toll-road features of full control of access, wide traffic lanes, separated roadways, bituminous stabilized shoulders, grade separations at all crossings, and no pedestrians. Connecticut now has 126 miles of such controlled-access routes.

Roads Versus Toll Roads

ROY E. JORGENSEN, M. ASCE

Deputy Commissioner and Chief Engineer, Connecticut State Highway Department, Hartford, Conn.

WHY DO WE HAVE toll roads? It is obvious that we have toll roads because there is something wrong with our free roads and little promise of an early remedy of the situation. Motorists don't pay tolls if they have a reasonable alternative. And there would be little enthusiasm for investment in toll facility bonds if the prospects were bright for free road development. What, then, is wrong in the free road picture?

Many miles of our main highways were built years ago, when the volume of motor traffic was small and there was little indication of the future development of this form of transportation. These roads are poorly adapted to the service of present-day motor traffic. Looking back now we can see where things might well have been done differently, such as wider rights-of-way and better alignment. But the problem thirty years ago was to get hard-surfaced roads for year-round travel. The problem of congestion, now critical on our main roads, was not then a factor.

The age status of the Connecticut State Highway system in 1948 is given in Table I. The traffic index with 1950 as 100, shows the extremely significant relationship between the traffic in specific years. Fourteen percent of the present road system was built before 1918. And, as the traffic index shows, for every 8 relatively slow-moving automobiles then using the road there are now 100 high-speed autos and trucks using the same road. Twenty-eight percent of the system, as it now exists, was built before 1923 and over half (52.4 percent) before 1928. For every 100 motor vehicles now using these roads there were 19 in 1923 and 37 in 1928.

TABLE I. CONNECTICUT STATE HIGHWAYS, 1948

Age, Years	Cumulative Percentage	Traffic Index (1950 = 100)
Over 30	14.3	1918 = 8
Over 25	28.0	1923 = 19
Over 20	52.4	1928 = 37
Over 10	87.4	1938 = 69

Because a large part of the highway system is old, the character or standards for individual road sections are likely to be poorly adapted to present-day traffic. Widths generally will be inadequate for safe, congestion-free movement. Line and grade in many cases are bad and the resulting short sight distances become critical elements in their effect on moving traffic.

Poor Progress on Main Highway Construction

It is continuously being said that we are losing ground in the construction of highways—that increased traffic and obsolescence of the road system are creating requirements for highway improvements faster than construction is going forward. This observation would probably be endorsed almost unanimously by motorists but, strangely, highway engineers have not presented well-codified evidence to support the observation. Lack of factual information on such matters may well be one of the deterrents to a sounder approach to the highway development-problem. One approach to the development of significant data on construction progress as related to requirements is presented in Fig. 1.

In the establishment of a program of highway improvement in the years before the war, the State of Connecticut adopted, as one of the controls on the program, the provision in rural areas of a four-lane highway for traffic volumes of 6,000 and more vehicles a day. Thus, as of 1939, we had a backlog of 44 miles of two-lane rural road requiring replacement by four-lane facilities (Fig. 1). And we recognized then, as we do now, the very great importance of this element in the program—the provision of greater capacity and greater safety on the congested two-lane roads. The curve for 1949 indicates how inadequately we have been able to take care of this in the face of further requirements created by increases in traffic volume. In 1949 we had a backlog of 81 miles of two-lane rural state highway carrying 6,000 or more vehicles a day, an increase of 37 miles over 1939. Here we have positive evidence that we have been losing ground. Instead of getting the 44 miles of 1939 converted to four-lane facilities and holding our own with requirements imposed by increased traffic, we have lost ground to the extent that the 44 miles has increased to 81 miles, in spite of construction accomplishments in the intervening years.

This sort of curve can show, too, what must be done in the future to

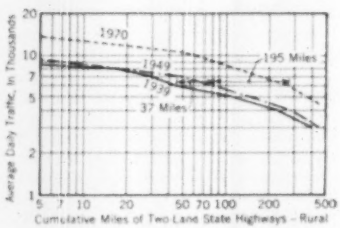


FIG. 1. INABILITY of rural road construction to keep up with traffic needs is shown by curves for 1939, 1949 and 1970. Traffic volume on two-lane rural state highways in Connecticut continues to increase despite new construction. For any point on curve, abscissa is mileage of road on which traffic volume equals or exceeds ordinate value. Thus, in 1939, there were 44 miles of rural, two-lane state highway on which traffic volume was 6,000 or more vehicles per day. This backlog of 44 miles requiring replacement by four-lane facilities had increased to 81 miles in 1949 despite new construction, and would be increased another 195 miles by 1950 with anticipated traffic expansion.

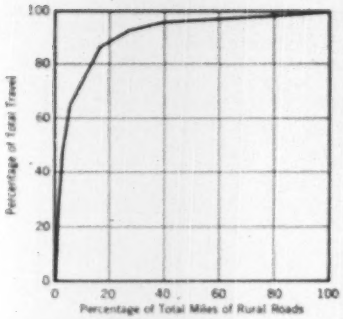


FIG. 2. SMALL percentage of nation's rural roads carry large percentage of rural traffic. One percent (30,000 miles) carry 27 percent of rural travel, and 5 percent (150,000) carry 63 percent. Data for curve are from U.S. Bureau of Public Roads, based on state traffic survey.

meet the requirements of present and future traffic. The curve for 1970 has been drawn to reflect the situation, with the anticipated increase in traffic, if no four-lane replacements of two-lane rural roads are undertaken. Simply because of the increase in traffic we shall have another 195 miles of two-lane road falling into the traffic volume group above 6,000 vehicles a day. This is an average of about 9½ miles a year. If the program of four-lane replacement of two-lane rural roads goes forward at less than 9½ miles a year, the present unsatisfactory situation will get worse. If the progress exceeds 9½ miles a year, there will be an improvement of congestion and hazardous conditions on our main routes, the rate of improvement depending upon the extent the 9½-mile-a-year rate is exceeded.

Free-Road Financing Is Ineffective

Failure to keep pace with the requirements for road improvements all over the nation is demonstrated by the comparative cost requirements for modernization of the Federal-Aid Highway Systems as prepared for 1947 and 1949. The estimate developed by the American Association of State Highway Officials for 1947 was $22 billion. As of December 1949 it was $28.9 billion, an increase of $6.9 billion, or 31 percent. Some of this was due to the rising price level—probably 5 to 10 percent. There is no doubt, however, that it reflects largely the growing backlog of needed improvements created by a lagging free-road construction program.

Just as "everybody's business is nobody's business," so it seems that "everybody's highway is nobody's highway." The main routes of the country are the life lines of motor transportation. The road-need studies of the states and the cooperative federal-state investigations that have culminated in the Bureau of Public Roads' reports, "Interregional Highways" and "Highway Needs of the National Defense," have established the vital importance of a relatively small mileage of the total road system. The National System of Interstate Highways is but 1 percent of the total road and street mileage, yet it carried 20 percent of the total rural traffic and 10 percent of the total urban traffic.

Figure 2 presents a cumulative curve of rural road mileage for the United States, regardless of system designation, beginning with the most heavily traveled routes. Ten percent of the roads carry almost 80 percent of the traffic. These heavily traveled routes are the most important farm-to-market roads because they collect the travel from feeder routes throughout their length and funnel it to the markets. They are the routes of strategic importance—both in war and in peace—because they connect the industrial and commercial centers of the country. They are the routes of primary social and recreational importance as they serve the tourist, the country visitor to town and the city dweller on his outing in the country. Truly, they are everybody's roads. Yet, the trend of highway finance and the pressures for special attention indicate all too clearly that in our free-road setup, "Everybody's road is nobody's road."

It would seem that the interest of the federal government in road development is primarily in the major routes that have strategic importance in time of war, and in peacetime carry large volumes of interstate traffic. Likewise, the state's responsibility and interest might be expected to center in the important

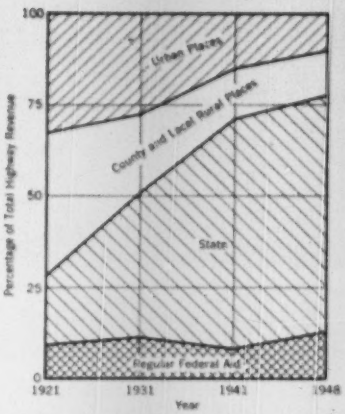


FIG. 3. GROWING contribution of states and decreasing proportional contribution of local governmental units to total U.S. highway revenue is shown by graph for years 1921–1948.

traffic arterials. Traffic surveys continually establish the local character of traffic moving on all but the most important routes. The major traffic arterials—everybody's roads—are in bad shape. But, what have state and federal governments been doing to meet the needs of these routes? And what have local governments been doing to carry the burden on local roads?

Federal highway aid since 1921 has represented a fairly consistent percentage of the total street and highway expenditures (Table II). Federal aid was 9 percent of the total highway budget in 1921, 11 percent in 1931, 8 percent in 1941, and 12 percent in 1948. However, in 1921 and in 1931 the federal-aid funds were earmarked for the federal-aid primary system, roughly the 7½ percent of the most important routes in the states—certainly the major arteries and routes which truly could be called "everybody's roads." However, beginning in the depression period of the 1930's, there have been

ONCE CONSIDERED LAST WORD in road construction, this Connecticut State Highway is functionally inadequate for present-day traffic. Roads like this or poorer are overburdened with bulk of nation's vehicular traffic. No wonder there is strong demand for toll roads which, however, cannot possibly solve the vast major highway problem.

TOLL ROADS are 100 percent rural and do not solve urban congestion problems. This urban route, engineered for vehicular traffic through Hartford, Conn., marks beginning of program of free express highway construction designed to bring freedom of movement, efficiency and safety sorely needed in our cities and on main rural roads that serve them.

TABLE II. SOURCES OF PUBLIC ROAD FUNDS

Sources	1921 Millions	1921 %	1931 Millions	1931 %	1941 Millions	1941 %	1948 Millions	1948 %
Regular federal aid	$ 87	9	$ 242	11	$ 154	8	$ 359	12
State	196	19	891	39	1,225	63	1,943	65
County and local rural	400	39	493	22	269	14	370	12
Urban	337	33	643	28	295	15	325	11
Totals	$1,020	100	$2,269	100	$1,943	100	$2,997	100

apportionments of funds for secondary roads and increasing demands for broader participation by the federal government in local road improvement. Recent deliberations by the Senate Subcommittee on Roads and the bill drafted by that subcommittee illustrate the ineffectiveness of free-road financing. An expansion of federal aid for secondary roads is proposed to increase the annual authorization to $200 million. Further, it is proposed that first priority in the expenditure of these monies be given to local rural roads. Only if this can be certified as "impractical" could these funds be used on state highways.

This federal legislation for free roads is being framed at a time when we have before us two well-documented, recently published reports prepared at the request of Congress dealing with (1) highway for the national defense (the Interstate System) and (2) the local rural-road problem. The first report indicated clearly the urgent need for rapid improvement of the Interstate System. The second report concludes that the local-road finance problem is one which should be solved within the states and that, in large part, it can be solved by more adequate support from local governments. In spite of the factual data available, it appears that federal legislation may be enacted to satisfy the pressures for financial aid to local governments rather than to meet the highway needs of the nation as a whole (Fig. 3).

That is the situation at the federal level. As for the states, it will be seen from Table II that the proportionate share of total expenditures from state revenue sources has shown a tremendous increase, from 19 percent in 1921 to 65 percent in 1948. But during that period the obligations against those funds have increased greatly. State highway systems have been expanded to include roads previously under local jurisdiction. In four states all rural roads have been made a responsibility of the state. Dispersion of large amounts of state revenue to local governments for local roads has occurred in almost all the states. And, in general, financial assistance to local governments has been followed by reduction in local support for roads. The road users, whose

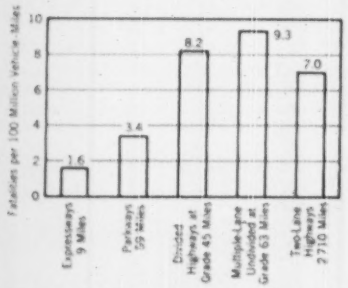


FIG. 4. FATALITY RATES on state-maintained highways in Connecticut, 1940–1948, are greatest on multiple-lane undivided routes and least on expressways.

contributions represent almost the total of state highway revenue, have seen their funds, in effect, go for local tax relief at a time when the major roads of the country were becoming increasingly congested and unsafe for lack of needed improvements. In 1927, county and local revenue for roads under county and local jurisdiction totaled $512 million for the country as a whole. State revenue provided only $119 million for these local roads. In 1947, county and local contributions were reduced to $330 million, and state revenues increased to $470 million.

The past trend of highway finance (and current indications are that no early change can be contemplated) gives little encouragement to the road-using public for early relief through free-road financing. It might be concluded that the interests of tax relief to local governmental units are being given priority over the need for improvement of major traffic arteries.

The most important feature in a modern highway which is to serve heavy volumes of traffic is the control of access from abutting properties. This control is fundamental to toll roads, to restrict use to toll-paying motorists. But on *all* major traffic arteries it is essential to guarantee that the service value of the facility will not be depreciated by road-bordering development. Many a structurally sound highway of the 1930's—yes, and even of the 1940's—is now functionally ineffective because of the "stringtown" development which has grown up along the road. Many a free road being built today without adequate control of roadside development will never reach its full effectiveness and, most important, will certainly become less efficient and less safe as the years go by.

In our state, Connecticut, the present standards for major route improvements include provision for full control of access. This provides the type of facility we designate as Parkway (passenger vehicles only) or Expressway (all types of motor vehicles). Opposing traffic on these facilities is separated by a dividing strip. Cross traffic is carried over or under by bridge structures. Entrances and exits are permitted only at established access roads. Moderate grades are used and alignment is designed for high-speed operation. Pedestrians are prohibited.

Other states have standards practically identical to those of Connecticut. However, some states are developing their major facilities with

what is called partial control of access. Structurally, the facilities are little different from fully controlled highways. Generally, they represent the utilization of existing rights-of-way, and partial control is adopted to permit the continuance of existing property entrances. Partial control creates a problem of providing for crossing movements from property entrances, with resulting undesirable conflict. Furthermore, separation of cross traffic at existing crossroads is frequently impracticable with the result that signalized intersections or sign-controlled crossings may be necessary.

In the opinion of the writer, partial control of access should not be adopted without careful consideration of the alternative of full control, probably on new alignment. Partial control, which may look like a cheaper way out now, may be found inadequate later. The early parkways, the expressways and the toll roads have demonstrated the continuing service values associated with complete control of access. Too little recognition of this fact and slow progress in providing these facilities on free roads is an important factor in the development of enthusiasm for toll roads.

Indicative of the continuing values associated with the development of controlled-access highways is their safety record. In Connecticut, we have a fatality rate on our parkways of 3.4 per 100 million vehicle-miles of travel. It is 1.6 on expressways. Against these rates may be placed the rest of the state highway system (Fig. 4). The divided highway at grade, rate 8.2, has some of the characteristics of a partially controlled highway. The parkways and expressways have full control of access. The better rate on the expressways than on the parkways in Connecticut is in part due to the improved design characteristics, wide paved shoulders, and better line and grade—characteristics included in the expressways but not in the earlier parkway construction.

What progress is being made in providing controlled-access free highways as compared with toll highways? The best information available is:

Type of Road	Controlled-Access Highways		
	Rural	Urban	Total
Free	261	277	538
Toll	389	—	389
All roads	650	277	927

There is an additional mileage of partially controlled facilities totaling 874 miles.

TRAFFIC CONFLICTS so typical of major highways in urban areas occur in abundance on the nation's No. 1 highway, U.S. Route 1, here seen where it passes through main street in Norwalk, Conn. Yet, studies indicate, an increase in highway funds of one-third cent per mile of travel would finance complete modernization of nation's roads over period of 15 years.

It will be noted that the toll roads are 100 percent rural. This is to be expected, as such facilities are not well adapted to urban areas where frequent interchanges, coupled with very high traffic densities, would make toll collections impracticable.

The significant thing about the comparison is that in rural areas the mileage of toll roads exceeds that of free roads with controlled access. Only 261 miles of rural free roads have full controlled access. There are 389 miles of toll road, and present indications are that this mileage will be increased to about 1,000 in the next several years. What about the free roads? What are the total requirements for this type of highway?

In Connecticut at present there are 126 miles of controlled-access highways in operation. An additional 124 miles are legally designated for construction, and a further designation of 200 miles is contemplated. Thus there is a total of 450 miles to be developed to the controlled-access standard, roughly 3 percent of the total road and street mileage. But Connecticut is more intensely developed than much of the country, with a higher percentage of roads of high traffic density. Still, even 1 percent of the nation's roads totals more than 30,000 miles. The Interstate System of

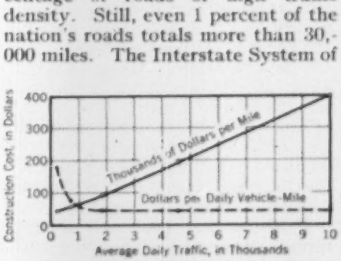


FIG. 5. CURVE of construction cost per mile for rural state highways in Connecticut goes up but curve of cost per daily vehicle-mile goes down, showing that high-standard facilities for heavily traveled routes actually cost less in terms of user service.

about that length has been recommended for development with controlled access.

Since many states have large mileages of important, heavily traveled highways not on the Interstate System, it appears that the total mileage requiring controlled access is somewhere between 1 and 3 percent. If it is 2 percent, it means about 60,000 miles. Assuming that 1,000 miles, or even 2,000 or 3,000, represents a fair estimate of the mileage that will be developed as toll roads, it can be seen that many thousands of miles have to be developed otherwise if the major highway routes of the country are to be modernized. Accomplishments to date represent only a meager start on the program. It is no wonder that the motoring public, so anxious to have and to pay for this kind of highway, has been encouraged to look to the toll highway for a solution of the problem.

Pros and Cons of Toll Roads

A great many arguments have been advanced for and against toll roads. Some, I believe, are unsound—such as the one that "super" highways should be paid for by an extra fare levied on the users of such luxurious facilities. This argument ignores two things. First, it is necessary to build a high-standard facility, either as a free or a toll road, where the traffic volume requires it. Second, such roads are not more expensive, in relation to the traffic served, than less important roads even though they are more costly per mile of construction (Fig. 5). Other arguments deal with the questions of equity in cost apportionment and with the undemocratic character of toll roads. I steer clear of these considerations because I don't believe they are controlling elements in the creation of the demand for toll facilities nor will

they be determining factors in providing a solution to the financing problem.

There are some good arguments on both sides of the toll-road question.

Toll roads provide good highways now. It has been demonstrated that toll roads can be financed and built to give an effective modern highway within a short time. This is accomplished by bond financing and by the utilization of private engineering organizations. This type of financing permits the completion of the facility before the road-using public has to start paying for it. Utilization of private engineering organizations permits rapid development of plans and adequate engineering coverage of construction, which would be difficult to accomplish with government forces.

Bond financing and the utilization of consulting engineering services could be used to provide good free roads now. But to date there is only limited acceptance of the idea of bond financing of free roads. And in the absence of an expanded free-road program, government road building agencies are generally able to perform the required engineering.

Toll-road financing counters diversion and dispersion. When road-user taxes are diverted to non-highway purposes, as they are in part in some states, there can be little road-user enthusiasm for a free-road program. Likewise, when legislative actions or administrative policies give primary emphasis to local roads—in effect providing local tax relief—the road users acquire a dim view of the potentialities of free-road financing for major traffic arteries. Under toll-road financing the motorist pays for the road he is using. He pays when he uses it and in proportion to the amount he uses it.

Toll roads provide high-standard controlled-access highways. Because they must be operated in competition with free highways and because they must be soundly engineered to pass the test of the engineers' earnings report, toll roads must be built to high engineering standards. They have to be good when they are built and retain that character under years of service.

Free roads can and should be equally as good as toll roads. Some are. But the government organizations building free roads are not faced with the same unequivocal requirement imposed by toll-road financing. As a result, free-road construction frequently represents an undesirable compromise between sound engineering and the desire to spread the available funds as far as possible.

Toll-road enthusiasm is misleading. Because of the great enthusiasm of motorists for such toll roads as are in service, the impression appears to have developed that here we have the answer to our highway finance problem. However, there are many major traffic movements for which toll highways are impracticable.

Urban areas with high property values, large volumes of traffic, and the necessity for frequent interchanges are not suited to toll-road operation. This fact is demonstrated by what has been done and is at present being planned for toll roads. They are all rural.

It has been demonstrated that rural roads can be financed from tolls. But a review of the engineering studies for these roads indicates the fine balance that is required between the cost of construction, the volume of relatively long-distance travel, and the inadequacy of existing free roads. Toll-road financing, at best, can satisfy but a small part of the requirement for major road modernization.

Toll roads are a deterrent to free highway improvements. Toll roads cannot stand competition from free roads. Financing of a toll road is dependent on sufficient traffic to pay operating costs and bond interest and retirement. This traffic is diverted from parallel free roads which are functionally inadequate; they must be inadequate, otherwise traffic would not choose a road on which tolls are collected. The paralleling free roads must remain inadequate—must not be improved to modern standards—because they would then undermine the financial soundness of the toll-road bonds. However, these paralleling free roads may be important highways because of the local service they provide, service that cannot be duplicated by the toll highway. Many motorists have no choice but to continue to use the free highway. But because of the competitive position of this free highway, they are doomed to use an obsolete facility in order to insure the financial soundness of the toll highway.

Toll-road and free-road planning are not integrated. The tremendous national importance of motor transportation requires the development of continuing long-range plans for the modernization and expansion of road and street systems. Highway officials, assisted by legislative and lay committees, are working toward this end in many states. The end goal is to establish a complete highway program covering the requirements of all roads and streets, together with a financial plan for its accomplishment. The present impetus for development of toll roads and the planning of such roads is not integrated with the total highway plan.

Because so much of the highway system is inadequate and because the relief provided by toll roads is so striking, the long-term effect of toll roads on the total highway picture is not now apparent. But a continuation of the present uncoordinated approach to the planning of the highway system as a whole is bound to bring a conflict before long.

The same result would be achieved by employing a general contractor to remodel a house according to a plan, and then engaging a special contractor to put in a bathroom first wherever, in his judgment, it ought to go, and without relation to the total plan. The bathroom would work all right; and if nothing but outside plumbing had previously been available, no doubt the enthusiasm for the new facility would be similar to that generated by toll roads. However, when the general contractor found that the bathroom had to be removed for a stair well or converted into a part of the kitchen, there would be somewhat less enthusiasm for that particular bathroom.

Lessons Learned from Toll Roads

Toll roads have demonstrated effectively several things that are extremely important in the total highway picture:

1. Good roads are worth more to the motorist than it costs to build and maintain them. On the toll roads the passenger-car operator must pay an extra charge of one cent or more a mile. Studies of the entire United States road and street system indicate that an increase in highway funds of approximately one-third of one cent per mile of travel would finance complete modernization over a period of 15 years.

2. Bond financing provides acceleration of road modernization, and permits pay-as-you-go instead of pay-before-you-go financing.

3. Motorists appreciate the direct tie-in between toll payments and the highway. Diversion of highway funds in some states to other than highway purposes, and the dispersion of funds have given the motorist a skeptical attitude toward free-road finance.

Diagram Determines Pipe Sizes Directly

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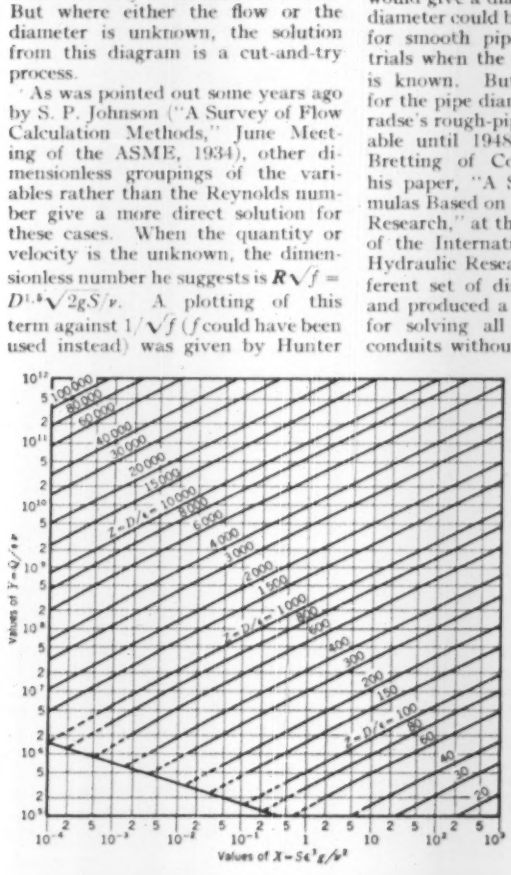
TO DETERMINE the slope of the hydraulic gradient in a pipe, it has become quite usual to plot f as a function of the Reynolds number, with a network of lines representing the relative roughness. This method gives a direct solution where the size of pipe, the quantity of flow, the equivalent roughness, and the kinematic viscosity of the fluid are known But where either the flow or the diameter is unknown, the solution from this diagram is a cut-and-try process.

As was pointed out some years ago by S. P. Johnson ("A Survey of Flow Calculation Methods," June Meeting of the ASME, 1934), other dimensionless groupings of the variables rather than the Reynolds number give a more direct solution for these cases. When the quantity or velocity is the unknown, the dimensionless number he suggests is $\boldsymbol{R}\sqrt{f} = D^{1.5}\sqrt{2gS}/\nu$. A plotting of this term against $1/\sqrt{f}$ (f could have been used instead) was given by Hunter Rouse at the 1942 Hydraulics Conference at the State University of Iowa and is repeated in his *Mechanics of Fluids* (John Wiley & Sons, New York, 1946, p. 211).

Johnson's suggested dimensionless grouping for use when the diameter is unknown is Q^2Sg/ν^5. A plotting of this quantity against f or $1/\sqrt{f}$ would give a diagram from which the diameter could be determined directly for smooth pipes, or by successive trials when the equivalent roughness is known. But no direct solution for the pipe diameter based on Nikuradse's rough-pipe formula was available until 1948, when Prof. A. E. Bretting of Copenhagen presented his paper, "A Set of Practical Formulas Based on Recent Experimental Research," at the Stockholm meeting of the International Association for Hydraulic Research. He used a different set of dimensionless numbers and produced a "universal diagram" for solving all problems in closed conduits without successive approximations. However, his diagram is not based directly on Nikuradse's formulas, but on exponential formulas which approximate them.

The writer presents herewith a diagram (Fig. 1) which is based directly on Colebrook's formula:


Values of $Y = Q/\epsilon\nu$
Values of $X = S\epsilon^3g/\nu^2$
$Z = D/\epsilon = 100{,}000$
$Z = D/\epsilon = 80{,}000$
$Z = D/\epsilon = 60{,}000$
$Z = D/\epsilon = 40{,}000$
$Z = D/\epsilon = 30{,}000$
$Z = D/\epsilon = 20{,}000$
$Z = D/\epsilon = 15{,}000$
$Z = D/\epsilon = 10{,}000$
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$Z = D/\epsilon = 4{,}000$
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$Z = D/\epsilon = 1{,}500$
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$Z = D/\epsilon = 600$
$Z = D/\epsilon = 400$
$Z = D/\epsilon = 300$
$Z = D/\epsilon = 200$
$Z = D/\epsilon = 150$
$Z = D/\epsilon = 100$
$Z = D/\epsilon = 80$
$Z = D/\epsilon = 60$
$Z = D/\epsilon = 40$
$Z = D/\epsilon = 30$
$Z = D/\epsilon = 20$

FIG. 1. Diagram solves problems of closed conduits without successive approximations. Diagram is dimensionless, and can be used with any consistent system of units.

$$\frac{1}{\sqrt{f}} = 1.74 - 2\log_{10}\left(\frac{2\epsilon}{D} + \frac{18.7}{\boldsymbol{R}\sqrt{f}}\right) \quad (1)$$

in which D is the pipe diameter; ϵ, Nikuradse's equivalent roughness; $\boldsymbol{R}$, the Reynolds number, VD/ν; and f, the Fanning coefficient, $2gDS/V^2$. As is well known, this formula reduces to Nikuradse's smooth-pipe formula when $\epsilon = 0$, and to his rough-pipe formula when $\boldsymbol{R} = \infty$. It represents the best information we have to date on the resistance to flow in pipes, except that it does not attempt to include waviness of the pipe walls, a matter which Bretting has treated most interestingly.

The dimensionless groupings used are $X = S\epsilon^3g/\nu^2$, $Y = Q/\epsilon\nu$, and $Z = D/\epsilon$, S being the slope of the hydraulic gradient, and ν the kinematic viscosity of the fluid. As illustrated in the example below, the data give X and Y, and at the point determined by these coordinates, Z can be read. And Z multiplied by ϵ will give D. At first sight it would appear that if ϵ is taken twice too large, D will be twice too large, but since ϵ appears also in X and Y, this conclusion is not true, as is shown in the example.

The diagram is based on the following considerations:

Let $\epsilon V/\nu = U$. Then

$$X = S\epsilon^3g/\nu^2,$$

$$\frac{fV^2\epsilon^2}{2D\nu^2} = \frac{fU^2}{2Z} \quad (2)$$

$$Y = Q/\epsilon\nu = \pi D^2V/4\epsilon\nu = 0.7854UZ^2 \quad (3)$$

$$\text{Also} \qquad UZ = \epsilon VD/\nu\epsilon = \boldsymbol{R} \quad (4)$$

From Eq. 2, $1/\sqrt{f} = U/\sqrt{2XZ}$, which combined with Eqs. 2 and 4 gives $U = \sqrt{2XZ}\,[1.74 - 2\log_{10} \times (2/Z + 18.7/Z\sqrt{2XZ})]$.

Then from Eq. 3,

$$Y = 0.7854Z^2\sqrt{2XZ}\,[1.74 - 2\log_{10}(2/Z + 18.7/Z\sqrt{2XZ})] \quad (5)$$

To construct the diagram, first select a value of Z, and then for various assumed values of X compute the corresponding values of Y by Eq. 5. Plotted, these values give that particular Z line on the diagram. Equation 1 does not apply when $\boldsymbol{R}$ is less than 2,000 and only uncertainly up to about 4,000, so that the lines are stopped at $Y = 1571Z$ and drawn dashed from $Y = 3142Z$.

Example Illustrates Use of Diagram

It is desired to pump 0.67 cfs of kerosene (kinematic viscosity 3×10^{-5} sq ft per sec) through 2,000 ft of pipe with a head loss of 10 ft. What size pipe is required if its equivalent roughness is 0.00015 ft? What size if the equivalent roughness is 0.0015 ft?

For the first case,

$$X = 5 \times 10^{-5} \times 1.5^3 \times 10^{-10} \times 32.16/9 \times 10^{10} = 0.603 \times 10^{-5}$$

$$Y = 0.67/1.5 \times 10^{-5} \times 3 \times 10^{-5} = 1.49 \times 10^{9}$$

From Fig. 1, $Z = 3{,}600$; therefore $D = 3{,}600 \times 0.00015 = 0.54$ ft. For the second case with $\epsilon = 0.0015$ ft, $X = 0.603$ and $Y = 1.49 \times 10^{7}$. These give $Z = 390$, and $D = 390 \times 0.0015 = 0.585$ ft. It is therefore unnecessary to know ϵ with great accuracy to get satisfactory accuracy in determining D.

The same diagram could be used to determine the loss of head or the quantity for a given diameter, but here the accuracy would be poor and one of the other diagrams that have been mentioned is to be preferred.

The diagram as given is dimensionless and can be used with any consistent system of units. If it is desired to restrict it to the foot-second system, g may be given the value 32.16 and a new horizontal scale used which gives Se^3/ν^2. If we limit ourselves to water at 58.1 deg F, $\nu = 0.0000125$ and a vertical scale giving Q/ϵ, and a horizontal scale giving Se^3 could be used. And finally, if we limit ourselves to one sort of pipe, X can be replaced by S, Y by Q, and Z by D. Such diagrams have been published for many years with the lines straight. The curvature of the Z lines in Fig. 1 shows the error inherent in such charts. It is not great, but if the Z lines are extended back to the left edge with the slope of one-half (which they have at the right edge) the error in Q is about 14 percent.

The following values of ϵ, in feet, are suggested:

Material	New	Old
Wrought iron and steel	0.0002	0.008
Asphalted cast iron	0.0004	0.007
Galvanized iron	0.0007	0.015
Bare cast iron	0.0008	0.018
Sheet metal with surfaces unbroken by offsets or rivet heads	0.0010	0.010
Girth riveted	0.0011	0.012
Cement-lined steel	0.0013	0.004
Full riveted sheets up to 1/16 in.	0.0020	0.018
Monolithic concrete (steel forms)	0.0023	0.006
Full riveted sheets 1/16 to 1/8 in.	0.0035	0.019
Full riveted sheets 1/8 in. and up	0.0050	0.02

Vacuum Breaker Prevents Back Siphonage to Potable Water Supply

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DANGEROUS CONDITIONS still exist on many water supply systems, as evidenced by outbreaks of waterborne diseases. From 1938 through 1945, there were 327 outbreaks in the United States resulting in 111,320 cases of water-borne disease. These outbreaks in general were not caused by inadequate design of water treatment plants but by inadequate supervision or carelessness in operation. Twenty-three of the epidemics, resulting in 44,899 cases of disease, were caused by cross connections or back flow on distribution systems. (See "Analysis of Water-Borne Outbreaks, 1938-1945," Rolf Eliassen and R. H. Cummings, *Journal of American Water Works Association*, May 1948.)

Both direct and indirect cross connections are frequent causes of contamination of drinking water.

Direct cross connections are often found on swimming pools, air conditioning systems, centrifugal pumps which require priming, and wherever auxiliary water supplies are available for fire protection or for processing purposes in industrial plants. Direct cross connections can easily be eliminated by: (1) the use of separate pipes to carry the potable water supply and the polluted supply; (2) the use of an elevated tank, which the potable supply enters by a pipe discharging at least 6 in. above the maximum water level; or (3) the use of a swing joint connection.

Indirect cross connections are generally due to back siphonage, caused by negative pressures. Negative pressures develop in water systems under the following conditions:

1. A break in a line on the water distribution system.
2. Shutting off and draining of the distribution system for repairs.

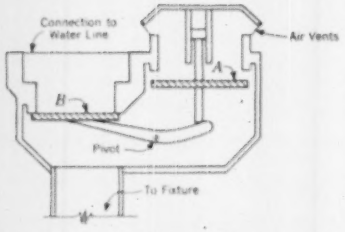


FIG. 1. VACUUM BREAKER on potable water line prevents back siphonage from fixture. Valve on pivot is shown in position assumed when water is not flowing or when negative pressure develops, which would result in back siphonage in absence of vacuum breaker. When water flows to fixture, water-stop *A* moves up to seal off vent and water-stop *B* moves down to permit passage of water. Vacuum breaker must be on discharge side of control valve and at higher elevation than fixture.

3. Heavy consumption of water on the lower floors of high buildings, which causes the water to be drawn from the higher elevation of the system to the lower elevation.
4. Booster pumps or fire-engine pumps which take suction direct from the distribution system.

Back siphonage may occur from many plumbing fixtures and installations found in homes, hospitals, industries, and public buildings. Some of the potentially dangerous installations are toilet bowls (flushometer valve type), bath tubs, lavatories, bed-pan sterilizers, autopsy tables, X-ray developing tanks, dish washers, clothes washers, potato peelers, bottle washers, flush tanks on sewer systems, air conditioning systems, and fire-protection sprinkler systems. Plumbing manufacturers are in most cases taking steps to prevent plumbing fixtures from contaminating the water supply by proper arrangement of the piping connection to provide a clear air break between the inlet and the fixture, or by the use of a vacuum breaker. Vacuum breakers are also being used on many older installations.

A vacuum breaker is a simple device placed in the water line to provide a direct opening to the atmosphere whenever a negative pressure occurs. This opening relieves the vacuum so that liquid cannot be siphoned back from the fixture. Vacuum-breakers should be located on the discharge side of the control valve on the water line and should be at a higher elevation than the fixture or apparatus to be protected. Many vacuum breakers are now available. One type is shown in Fig. 1.

Write

Weather Bureau Forecasts Defended

To the Editor: In the light of Professor Boardman's comments on water-supply forecasting in the May issue of Civil Engineering, it is interesting to compare the forecasts shown in the accompanying Table I (below). This table presents all the comparable forecasts for which verification data are available. It is to be noted that the Weather Bureau "guesstimates," as Professor Boardman calls them, on January 1, are more accurate than those issued April 1 on the basis of snow surveys.

Abnormal precipitation after the date of forecast is largely responsible for the errors in the tabulated forecasts—errors averaging well over the 15-percent limit cited by Professor Boardman. It is for this reason that the Weather Bureau publishes estimates of the runoff to be expected if precipitation during the period following the forecast is equal to the median, quartiles, or extremes of record. In other words, the water user is told what the odds in favor of certain departures from the forecast are. It is believed that this is a far more realistic picture of future water prospects than a single forecast value, limited by the assumption of normal precipitation. Weather Bureau forecasts listed in the table are the median forecast in each case.

A large part of the planning for water utilization must be done early in the spring. Consequently, the Weather Bureau forecasts issued in January, February, and March, before any forecasts based on snow surveys are available, are used by many interests for planning purposes. Since only half the season's effective precipitation occurs by February 1 in the average year, the range between the five values is naturally quite wide. Nevertheless, the table shows that there is not a serious loss in accuracy between the early median forecasts and those determined for April 1. Certainly, it is wiser for the water user to make his plans early in the operating year, subject to slight progressive changes, than to wait until the last moment when major shifts in schedules are difficult, if not impossible.

Because we use precipitation rather than residual snow, it is necessary to compute our forecasts in terms of flow volume for the total water year. Unfortunately, the data necessary to compute the discharge from October 1 to the date of forecast are not available to us in time to be included in the forecast bulletin. We are sure, however, that the water users who are vitally concerned with streamflow are informed of the flow that has taken place, and are prepared to deduct it from the forecast amounts. In any event, this early flow is a relatively small amount, as may be seen by comparing the flows for the water years and April–July periods in the accompanying table.

The annual cost of the Weather Bureau's Water Supply Forecast Service, which serves over 300 points covering the Western states, is less than $30,000. This low cost is possible because we use the regular climatological data that have been collected on a routine basis for many years.

An article entitled "Weather Bureau's Mountain Snowfall Work" (Civil Engineering, March 1939, pp. 173–175), and a paper, "Progress Report on Mountain Snowfall Program of the Weather Bureau" (*Transactions, American Geophysical Union*, 1940, pp. 122–131), describe the results observed at a portion of the 32 stations where batteries of five gages were installed over approximately one-half acre squares. The results showed excellent agreement between individual stations and the five-gage mean. On the basis of these tests, it was concluded that a single shielded gage was as satisfactory as the mean of a multiple-gage battery. Subsequent experience has confirmed this opinion.

Merrill Bernard, M. ASCE
Climatological and Hydrologic Services, U.S. Weather Bureau

Washington, D.C.

TABLE I. COMPARISON OF WATER SUPPLY FORECASTS OF WEATHER BUREAU AND SOIL CONSERVATION SERVICE
(All flows in thousands of acre-feet)

Stream and Station	Year	Observed Flow*		Weather Bureau (Water Year)												Soil Conservation Service (April–July)		
				January 1			February 1			March 1			April 1			April 1		
		Water Year	April–July	Forecast	Error	%	Forecast	Error	%	Forecast	Error	%	Forecast	Error	%	Forecast	Error	%
South Fork Humboldt River near Elko, Nev.	1948	58	45	88	+30	52	83	+25	43	78	+20	34	74	+16	28	75	+30	67
Humboldt River at Palisade, Nev.	1948	145	106	275	+130	90	235	+90	62	200	+55	38	195	+50	34	150	+44	42
	1949	234	201	245	+11	5	250	+16	7	290	+56	24	270	+36	15	300	+99	49
Martin Creek near Paradise, Nev.	1948	18	13	15.5	−2.5	14	14.3	−3.7	21	12.4	−5.6	31	13.8	−4.2	23	10	−3	23
Carson River at Carson City, Nev.	1948	170	131	167	−3	2	141	−29	17	125	−45	26	125	−45	26	70	−61	47
Carson River at Ft. Churchhill, Nev.	1948	151	113	155	+4	3	131	−20	13	116	−35	23	116	−35	24	68	−45	40
	1949	167	128	187	+20	12	166	−1	1	151	−16	10	162	−5	3	135	+7	5
West Walker River near Coleville, Calif.	1948	129	109	123	−6	5	90	−39	30	77	−52	40	76	−53	41	85	−24	22
	1949	133	117	142	+9	7	123	−10	8	115	−18	14	124	−9	7	165	+48	41
East Walker River near Bridgeport, Calif.	1948	52	†31	54	+2	4	41	−11	21	33	−19	36	34	−18	35	†20	−11	28
	1949	61	†39	59	−2	3	50	−11	18	43	−18	29	49	−12	20	†65	+26	67
Truckee River at Farad, Calif.	1948	246	171	450	+204	83	410	+164	67	360	+114	46	370	+124	50	115	−56	33
	1949	223	136	300	+77	34	235	+12	5	215	−8	4	230	+7	3	250	+114	84
Sum		1,787	1,340	...	500	314	...	432	313	...	462	355	...	414	308	...	558	548
Mean		...	...	...	38.5	24.1	...	33.3	24.1	...	35.6	27.3	...	31.9	23.7	...	43.7	42.1

* Preliminary data from U.S. Geological Survey.
† Period April–August.

Sees Room for Both Snow and Rain Data in Forecasting

To the Editor: Commenting on Mr. Bernard's table showing comparisons of U.S. Weather Bureau and Snow Survey forecasts of Nevada stream flow for the years 1948 and 1949, it is interesting as he notes that the Weather Bureau January forecasts are in numerous cases more accurate than the April 1 forecasts by the snow survey method. What he fails to mention, however, is that in more than half of the comparisons in the table those Weather Bureau January 1 forecasts from snow cover are also equal to or better than the April 1 Weather Bureau forecasts.

As to early forecasts, it is customary for snow surveys to be made at certain important or "key" stations in the western states monthly, beginning with February 1, and some years January 1 after heavy December snows. The results of these early surveys are given to the public through newspapers, with comments comparing them with other years or approximate normals.

I think the method of determining errors of estimate or forecasts in percentage used in the table is apt to be misleading. For example, suppose a certain stream for the forecast period discharges 100,000 acre-ft one year and 50,000 acre-ft another year. Suppose for the first year the forecast is 80,000 acre-ft and for the other year 70,000 acre-ft. The error is 20 percent in one case and 40 percent in the other case, and yet, in quantity, the error actually is the same in each case—20,000 acre-ft. Now if the normal flow of that river is 200,000 acre-ft for that period, the error in both years is 10 percent of normal.

The quantity of flow is of more interest to water users, especially those responsible for its control and distribution, than is percentage, but for comparison of different years in a given stream, or of different streams in a certain region, the use of some standard for each stream is practically essential. Call that standard a normal, and then express the acre-feet of flow in percentage of normal, and the results can be compared more easily than by the mere statement of number of acre-feet.

This matter of a standard for comparison is of extreme importance.

While I was participating in the forecasts of western Nevada streams, we stated our forecasts in acre-feet and in percentage of normal. Two forecasts were given, "probable" and "possible minimum." Any excess over the "probable" was generally very welcome. Then the next year's forecast bulletin included a table showing a comparison of the previous year's forecast with actual results in both acre-feet and percentage of normal so that the difference was naturally the forecast error in acre-feet and in percentage of normal. Those data had a definite, worthwhile meaning when comparing different years and different streams.

The U.S. Weather Bureau believes in normals because the "climatological data" always give "departures from normal"—very valuable information.

As Dr. Church has emphasized, the snow blanket of about April 1 is an accumulation of several months' precipitation held in reserve until warm weather takes it off in a relatively short time. It is more effective in producing surface flow than rain on ground because a much smaller proportion of it is required to prime the soil. Each separate rain storm falling on ground has to contribute considerable to the ground before much can reach the streams. In fact, in western Nevada most of the fall rain, and nearly all rain after April, falling on bare ground produces *practically no surface runoff* except from steep, rocky slopes.

In view of the greatly increasing interest in and appreciation of the importance of water supply, nationally as well as in the West, why need there be strife between different methods of attempting to shed light on the subject of foretelling what to expect each season? Some rivalry is to be expected, of course, but in engineering it is often good to have an important problem attacked by different methods.

Horace P. Boardman, M. ASCE
Reno, Nevada

Roots Solved by Steinman's Algorithm

[Space does not permit publication of the unusual number of inquiries and comments, stimulated by Dr. Steinman's brief article, "Engineer's Shortcut Solves Cubic and Higher Equations and Roots" (June issue, page 41), received by both the editor and the author. At the editor's suggestion the article was greatly condensed from the author's original monograph, scheduled for publication in a mathematics quarterly, making the presentation less than adequate. Dr. Steinman kindly reviewed the correspondence and has consented to make the following illustrative statement.]

To the Editor: My shortcut method (termed an "algorithm," meaning a conveniently routinized numerical procedure) yields the root of a higher-degree equation by a sequence of convergents. The convergence may be oscillating, with successive values alternately higher and lower than the limit but with the difference progressively diminishing.

If the sequence does not converge or converges too slowly, transform the equation to augment or reduce the unknown and then apply the algorithm. Convenient transformations include:

1. Substituting $y = 1/x$ (by reversing the equation).
2. Substituting $y = kx$.
3. Substituting $y = x + k$ (using synthetic division).

If the equation has more than one real root, the direct application of the algorithm will yield the numerically highest root; and, with $y = 1/x$, the algorithm will yield the numerically lowest root. After any root x_1 is found, divide the complete expression, $f(x) = 0$, by $(x - x_1)$ to reduce the equation, and repeat the operation to find the remaining roots.

The writer's method has been rigorously derived by writing the solution of a cubic (or higher degree) equation as a repeating continued fraction of novel type and then writing the successive convergents in the form of an algorithm. A highly simplified derivation is as follows: Given an algebraic equation such as $x^3 = ax^2 + bx + c$, then the successive approximations are:

$$r_1 = x = a \qquad = a$$
$$r_2 = x^2 = ax + b \qquad = ar_1 + b$$
$$r_3 = x^3 = ax^2 + bx + c \qquad = ar_2 + br_1 + c$$
$$r_4 = x^4 = ax^3 + bx^2 + cx \qquad = ar_3 + br_2 + cr_1$$
$$r_5 = x^5 = ax^4 + bx^3 + cx^2 \qquad = ar_4 + br_3 + cr_2, \text{ etc.}$$

The implied assumption is that the successive terms in the right hand side of the original equation are of diminishing importance. Steeply ascending coefficients and reversals of sign may represent gross departure from this assumption so as to prevent convergence. An extreme case is a missing second term represented by $a = 0$. In all such cases, a simple transformation of the original equation eliminates the difficulty. (See Examples 8, 9, 10, in the original article.)

The writer's method yields speedier convergence than Newton's Method and greater speed and simplicity than any other known method. The only disadvantage is that a transformation of the original equation is sometimes required. Against this, it should be noted that the conventional solution (by Horner's Method) requires transformation of the equation for each successive significant figure in the answer, in addition to requiring the roots to be found by trial (by synthetic division) at each step.

It is always possible to find or devise problems containing unfavorable relationships so as to place a given method of solution at a

seeming disadvantage. Nevertheless, the writer has not encountered any problem in cubic or higher-degree equations that cannot be solved advantageously by his method. The most difficult problems that have been submitted by correspondents are solved in the following examples.

Example D1:

To solve: $d^3 - 14d - 12 = 0$

In this case, the necessary second term is missing. By trial, d is close to 4. Hence, to supply the missing term, let $d = 4 + (1/x)$. This transformation is conveniently given by synthetic division, thus:

4)	1	0	−14	−12
		4	16	8
	1	4	2	−4
		4	32	
	1	8	34	
		4		
	1	12		

Hence, $4x^3 = 34x^2 + 12x + 1$

or $x^3 = 8.5x^2 + 3x + 0.25$

	8.5	72.25	. . .
		3	. . .
			0.25
r =	8.5	75.25	. . .

$$d = 4 + \frac{8.5}{75.25} = 4.113$$

The complete numerical work is given above.

Example D2: To solve:

$x^4 = -14x^3 + 478x^2 - 686x - 2401$

In this case the coefficients are steeply ascending, hence a transformation is needed to speed convergence. By trial, x is between 14 and 15. Hence a convenient transformation is $x = 14 + 1/y$. This substitution is carried out by synthetic division as in the preceding example, yielding:

$4851y^4 = 6510y^3 + 1286y^2 + 70y + 1$

or

$y^4 = 1.341y^3 + 0.264y^2 + 0.0144y + 0.0002$

	1.341	1.800	2.775	
		0.264	0.354	
			0.0144	0.0002
r =	1.341	2.064	3.1434	

$$x = 14 + \frac{2.064}{3.1434} = 14.657$$

No other method will give this answer (to five significant figures) with the same expedition.

Example D3:

To solve: $x^3 = 4.2x^2 - 30.9x + 293$

(This is the problem submitted by Anthony Hoadley, Assoc. M. ASCE, in the August issue, page 49). As in the preceding example (with steeply ascending coefficients and reversals of sign), a transformation is needed to speed convergence. By trial, x is between 6 and 7. Let $x = 6 + (1/y)$. This substitution (by synthetic division, as in Example D1) yields: $42.8y^3 = 88.5y^2 + 13.8y + 1$, or (with slide-rule accuracy)

$y^3 = 2.07y^2 + 0.322y + 0.023$

	2.07	4.285	9.536
		0.322	0.665
			0.023
r =	2.07	4.607	10.224

$$x = 6 + \frac{4.607}{10.224} = 6.451$$

Example D4:

To solve: $8x^3 = 9x^2 - 1$

By inspection, $x = 1$. Hence, divide the complete expression by $(x - 1)$, using synthetic division as follows:

1)	8	−9	0	1
		8	−1	−1
	8	−1	−1	0

Hence, $8x^2 = x + 1$. This quadratic equation may be solved either by the conventional method or by the writer's algorithm (substituting $y = x + 1$ or $y = x - 1$), yielding $x = 0.4215$ and $x = -0.2965$. (The sum of the three roots must equal the coefficient 9/8 in the original equation, and their product must equal the coefficient $-1/8$.)

Example D5:

To solve: $4x^3 = 18x^2 - 20x + 3$

The correspondent who submitted this problem found $x = 1.5$ by starting with this value as a trial root in the writer's algorithm, but could not obtain convergence to this root when he started with $x = 1.4$ or 1.6. That is because this equation has a higher root $x = 2.823$, which is given by direct application of the algorithm. To find the third root, substitute $x = (1/y)$ by simply reversing the equation, thus: $3y^3 = 20y^2 - 18y + 4$.

Application of the algorithm to this equation yields $x = 0.177$. When any two of the roots have been found, the third is given by the fact that their sum must equal the coefficient 18/4.

Example D6:

To solve: $x^3 - 100x - 150 = 0$

To obtain coefficients in descending order (for speedier convergence), let $x = 10y$, yielding $y^3 - y - 0.15 = 0$.

To supply the missing second term, let $y = z - 1$, using synthetic division, thus:

−1)	1	0	−1	−0.15
		−1	1	0
	1	−1	0	−0.15
		−1	2	
	1	−2	2	
		−1		
	1	−3		

Hence, $z^3 = 3z^2 - 2z + 0.15$

Applying the algorithm yields $z = 2.07$.
Hence $x = 10z - 10 = 10.7$

To obtain the other roots divide $f(x)$ by $(x - 10.7)$:

10.7)	1	0	−100	−150
		10.7	114	150
	1	10.7	14	0

Hence, $x^2 + 10.7x + 14 = 0$.

Applying the algorithm yields $x = -9.17$. The sum of the three roots must equal the coefficient (zero) of x^2 in the original equation. Hence, the third root is $x = -1.53$. For a check, the product of the three roots equals the absolute term (150) in the original equation.

Example D7:

One correspondent submits this cubic equation arising in his practice in structural design:

$x^3 = 46.35x^2 - 361.5x - 1400$

Applying the algorithm yields $x_1 = 34.81$

Divide by $(x - 34.81)$, using synthetic division:

34.81)	1	−46.35	+361.5	+1400
		34.81	−401.7	−1400
	1	−11.54	−40.2	0

Hence, $x^2 = 11.54x + 40.2$

Applying the algorithm to this quadratic equation yields $x_2 = 14.344$. The sum of the three roots must equal the first coefficient, 46.35. Hence, $x_3 = -2.804$.

Approximate trial roots, for speeding the convergence, may be found by roughly plotting the equation as $y = f(x)$; or by testing with synthetic division to find change of sign of the remainder. Thus, in the preceding example, synthetic division shows that there must be a root between $x = 34$ and 35, and another between $x = 14$ and 15. Partial application of the algorithm also yields an approximate value of the root, with which a new start may be made for expedited solution.

In my more comprehensive monograph on the subject, the method is extended to include the numerical solution of imaginary roots.

D. B. STEINMAN, M. ASCE
Consulting Engineer
New York, N.Y.

Annual Meeting—Chicago, Ill.

American Society of Civil Engineers

Congress Hotel **October 11–14, 1950**

Registration: Congress Hotel, opens 2:00 p.m., Tuesday, October 10; each convention day 9:00 a.m. to 5:00 p.m.
Registration fee (except ladies and students) $1.00

Ninety-Eighth Annual Business Meeting

WEDNESDAY, OCTOBER 11—10:00 A.M., GRAND BALLROOM, CONGRESS HOTEL

Presiding: Ernest E. Howard, President, American Society of Civil Engineers

10:00 Welcome to Chicago

By the City of Chicago, Hon. Martin H. Kennelly, Mayor, City of Chicago

Response

Ernest E. Howard, President, American Society of Civil Engineers.

10:30 Presentation of Honors and Awards

The Norman Medal to Friedrich Bleich, M. ASCE (posthumously).

The J. James R. Croes Medal to L. F. Harza, M. ASCE.

The Thomas Fitch Rowland Prize to R. N. Bergendoff and Josef Sorkin, Members, ASCE.

The James Laurie Prize to Harris Epstein (posthumously).

The Collingwood Prize for Junior Members to C. A. Lee and C. E. Bowers, Junior Members, ASCE.

The Arthur M. Wellington Prize to A. A. Anderson, Assoc. M. ASCE.

Authors' Breakfasts

ENGLISH WALNUT ROOM
CONGRESS HOTEL
Wednesday, Oct. 11, 8:15 a.m.
Thursday, Oct. 12, 8:15 a.m.
Friday, Oct. 13, 8:15 a.m.

Briefing sessions for all speakers, discussers, and program officials. *Presiding:* A. L. R. Sanders, Technical Program Chairman.

The Moisseiff Award to J. Nathan M. Newmark, M. ASCE.

11:15 Sessions for transaction of ASCE Business

Report of Tellers on Canvas of Ballot for officers.

Introduction of newly elected officers, who will take office Jan. 17, 1951.

12:00 Adjournment for Membership Luncheon

Membership Luncheon Wednesday, October 11, 12:30 p.m.

CASINO ROOM

Nathan Bederman, Annual Meeting Chairman, will introduce the speaker:

Rear Admiral Joseph F. Jelley, M. ASCE; Chief, Bureau of Yards and Docks, U.S. Navy, Washington, D.C., will deliver an address on

You Can't Buy National Defense

All members, their ladies, guests and friends of ASCE are cordially invited to attend this luncheon. Price $3.00 per plate.

Technical Division Sessions—Wednesday Afternoon, Oct. 11

Air Transport Division

2:00 P.M. **CASINO ROOM**

Presiding: H. Shifrin, M. ASCE, Chairman, Executive Committee, Air Transport Division

2:00 Development of Airport Standards

E. C. CriteS, M. ASCE, and Isaac Ledbetter, Assoc. M. ASCE, Civil Aeronautics Administration, Washington, D.C.

2:45 Aircraft Design as Related to Airport Standards

Milton W. Arnold, Vice-President, ATA.

3:30 Summary and Forecasts of Airport Standards

Harry O. Wright, Jr., M. ASCE, Consulting Engineer, Washington, D.C., and Ralph H. Burke, M. ASCE, Chairman, Committee on Airport Standards.

Highway Division

2:00 P.M. **FLORENTINE ROOM**

Presiding: John W. Wheeler, M. ASCE, Chairman, Executive Committee, Highway Division

2:00 Edens Parkway

William Mortimer, Assistant Superintendent of Highways, Cook County Highway Department, Chicago, Ill.

2:45 Trends in Highway Maintenance Cost

Robert H. Tittle, M. ASCE, Construction Engineer, Illinois State Highway Department.

3:30 Chicago Superhighways—A Comprehensive Plan

V. E. Gunlock, M. ASCE, Commissioner, Department of Subways and Superhighways, Chicago, Ill.

Power Division

2:00 P.M. **GOLD ROOM**

Presiding: Milton G. Salzman, M. ASCE, Chairman, Executive Committee, Power Division

2:00 Petenwell Hydraulic Project—An Unusual Foundation Problem

E. Montford Fucik, Assoc. M. ASCE, Harza Engineering Co.

2:45 Ridgeland Generating Station

Merle H. Gordjen, Assoc. M. ASCE, Commonwealth Edison Co.

3:30 Economies in the Structural Design of Hydroelectric Power Development

Samuel Judd, M. ASCE, U.S. Bureau of Reclamation, Denver, Colo.

Division Sessions—Thursday Morning

City Planning Division

9:30 A.M. **FLORENTINE ROOM**

Presiding: L. V. Sheridan, M. ASCE, Chairman, Executive Committee, City Planning Division

9:30 The Plan Commission and Its Role in the Progress of the City

NATHANIEL OWINGS, Chairman, Chicago Plan Commission.

10:15 The Regional Planning Association and Its Coordination of Planning in the Greater Chicago Area

ROBERT KINGERY, General Manager, the Chicago Regional Planning Association.

11:00 Planning and Development of Park Forest, Illinois

H. EVERT KINCAID, Consultant, Kincaid and Hutchinson.

Sanitary Engineering Division

9:30 A.M. **GOLD ROOM**

Presiding: Alfred H. Wieters, M. ASCE, Chairman, Executive Committee, Sanitary Engineering Division

9:30 Chicago Water Department Operating Data and Experience

W. W. DEBERARD, Hon. M. ASCE, City Engineer, Chicago, Ill.

10:15 Sanitary District of Chicago—Past, Present, and Future

LANGDON PEARSE, M. ASCE, Sanitary Engineer, Sanitary District of Chicago.

11:00 Diatomaceous Earth Filters

EDWARD R. BAUMANN, Jun. M. ASCE, University of Illinois, Urbana.

Soil Mechanics and Foundations Division

9:30 A.M. **CASINO ROOM**

Presiding: Philip C. Rutledge, Assoc. M. ASCE, Chairman, Executive Committee, Soil Mechanics and Foundations Division

SYMPOSIUM ON CHICAGO SUBSOILS

9:30 Introduction to Committee's Work and History of Building Construction in Chicago

F. A. RANDALL, M. ASCE, Consulting Engineer, Chicago, Ill.

9:50 Collection of Data by Committee

F. A. REICKERT, M. ASCE, Staff Member, University of Illinois.

10:10 History of Building Foundations in Chicago

V. O. MCCLURG, M. ASCE, Mundie, Jensen & McClurg, Chicago, Ill.

10:30 Description of Subsoil Conditions in Chicago

B. C. REED, Jun. M. ASCE, Macdonald Engineering Co., Joliet, Ill.

10:50 Comparison of Computed and Observed Settlement of Buildings in Chicago

C. P. SIESS, Assoc. M. ASCE, University of Illinois, and M. E. UYANIK, Jun. M. ASCE, North Carolina State University.

11:10 Future Problems and Work of Committee

R. B. PECK, M. ASCE, University of Illinois.

11:30 Discussions

Annual Meeting Dinner-Dance

Wednesday, Oct. 11

CASINO ROOM **CONGRESS HOTEL**

7:00 p.m. Cocktail Hour
8:00 p.m. Dinner
9:30 p.m. Dancing

Special arrangements can be made for tables seating 8. Members may underwrite complete tables. Orders for tables must be accompanied by a check in full and a list of guests.

Tickets purchased after 5:00 p.m., Tuesday, October 10, will be assigned to tables in order of purchase. Sale of tickets will continue until 5:00 p.m., Wednesday, October 11. Dress will be optional. Price, $7.50 per person, including cocktails and dancing.

Students are invited to the dinner-dance or to the dancing only, at 9:30 p.m. Student tickets, dancing only, $2.00 per couple.

Student-Junior Luncheon

Thursday, October 12, 12:30 p.m.

GOLD ROOM **CONGRESS HOTEL**

A program devoted to special interests of the Student and Junior Members of ASCE. All Society members are invited to attend. Price, $2.50 per person.

Technical Division Sessions—Thursday Afternoon

Structural Division

2:00 P.M. **GOLD ROOM**

Presiding: Craig P. Hazelet, M. ASCE, Chairman, Executive Committee, Structural Division

2:00 Design of Protective Structures—a New Concept of Structural Behavior

A. AMIRIKIAN, M. ASCE, Head Designing Engineer, Bureau of Yards and Docks, Navy Department, Washington, D.C.

2:45 Variation of Wind Velocity and Gusts with Height

R. H. SHERLOCK, M. ASCE, Professor of Civil Engineering, University of Michigan.

3:30 Dynamic Behavior of Structures

N. M. NEWMARK, M. ASCE, Research Professor of Structural Engineering, University of Illinois.

Men's Smoker-Show

THURSDAY, OCTOBER 12, 8 P.M.

An evening of good fellowship featuring EDWARD MCFAUL, as master of ceremonies, who will entertain with his talk, "So You Think You're Slipping!" There will be music for those who like to sing and plenty of beer and other refreshments. Sandwiches and coffee will be served.

Tickets, $2.50 each.

Soil Mechanics and Foundations Division

2:00 P.M. **CASINO ROOM**

Presiding: Philip C. Rutledge, Assoc. M. ASCE, Chairman, Executive Committee, Soil Mechanics and Foundations Division

2:00 Earth Movements in the Red River Valley of the North

H. M. HILL, M. ASCE, Northern States Power Co., Minneapolis, Minn.

3:00 Measurements on Test Tunnels at Garrison Dam

K. S. LANE, Assoc. M. ASCE, Garrison District, Corps of Engineers, Riverdale, N. Dak.

4:00 Discussions

Technical Division Sessions—Friday Morning, October 13

Hydraulics Division

9:30 A.M. **FLORENTINE ROOM**

Presiding: Albert S. Fry, M. ASCE, Chairman, Executive Committee, Hydraulics Division, and Harold M. Martin, Assoc. M. ASCE, Chairman, Committee on Hydraulic Research

9:30 Photoviscosity as a Technique in Flow Studies

W. W. Hagerty, Department of Engineering Mechanics, University of Michigan, Ann Arbor, Mich.

Discussion

John G. Duba, Jun. M. ASCE, Instructor in Civil Engineering, Illinois Institute of Technology.

10:15 Low-Velocity Air Testing Applied to Hydraulic Problems

James W. Ball, Assoc. M. ASCE, Hydraulic Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Discussion

W. S. Hamilton, Assoc. M. ASCE, Associate Professor of Civil Engineering, Northwestern University, Evanston, Ill.

11:00 Measurements of Boundary-Layer Development Along Smooth and Rough Surfaces

W. D. Baines, Jun. M. ASCE, and W. L. Moore, Assoc. M. ASCE, Research Associates, Iowa Institute of Hydraulic Research, State University of Iowa, Iowa City, Iowa.

Discussion

V. L. Streeter, M. ASCE, Research Professor, Illinois Institute of Technology, Chicago, Ill.

Waterways Division

9:30 A.M. **CASINO ROOM**

Presiding: Glen E. Edgerton, M. ASCE, Chairman, Executive Committee, Waterways Division

9:30 Water-Borne Commerce on the Great Lakes and Its Relation to Industry and Harbor Construction

O. M. Skrukrud, Civil Engineer, Milwaukee District, Corps of Engineers.

10:15 The Proposed Plan of Improvement of the Calumet-Sag Navigation Channel, Illinois and Indiana

J. P. Campbell, Assoc. M. ASCE, District Engineer, Chicago District, Corps of Engineers.

Discussion

W. H. Trinkhaus, M. ASCE, Chief Engineer, Sanitary District of Chicago.

11:15 Economic Aspects of the Sag-Channel

Stuart B. Bradley, Chairman, Harbors and Waterways Committee, Chicago Association of Commerce, Member of the Chicago Bar.

Construction Division

9:30 A.M. **GOLD ROOM**

Presiding: Ross White, M. ASCE, Chairman, Executive Committee, Construction Division

9:30 Subway Construction Under the La Salle Street Station

Dick Van Gorp, M. ASCE, Chief Engineer, Department of Subways and Superhighways, City of Chicago.

10:15 Water Intake on the Mississippi River

George F. Flay, Jr., M. ASCE, Drilled-In Caisson Corp., New York, N.Y.

11:00 Foundations of the Delaware River Bridge

Carl H. Cotter, M. ASCE, President, Merritt-Chapman & Scott Corp., New York, N.Y.

Technical Division Sessions—Friday Afternoon

Hydraulics Division

2:00 P.M. **FLORENTINE ROOM**

Presiding: Albert S. Fry, M. ASCE, Chairman, Executive Committee, and W. S. Hamilton, M. ASCE, Secretary, Executive Committee, Hydraulics Division

2:00 Settling Rate of Suspensions as Design Criterion for Clarification Basins

A. A. Kalinske, M. ASCE, Director of Development, Infilco, Inc., Chicago, Ill.

Discussion

Norval E. Anderson, M. ASCE, Engineer of Treatment Plant Design, Sanitary District of Chicago, Ill.

2:45 Scale Effect on Movable Bed Models Involving Waves

Joseph Caldwell, Assoc. M. ASCE, and Ralph L. Rector, Beach Erosion Board, Washington, D.C.

Discussion

William C. Krumbein, Department of Geology, Northwestern University, Evanston, Ill.

3:30 Comprehensive Water Resources Program for Kentucky

F. F. Schrader, Assoc. M. ASCE, District Engineer, Surface Water Branch, and M. I. Rorabaugh, Assoc. M. ASCE, District Engineer, Ground Water Branch, U.S. Geological Survey, Louisville, Ky.

Discussion

C. V. Youngquist, M. ASCE, Chief, Division of Water, Department of Natural Resources, Columbus, Ohio.

Waterways Division

2:00 P.M. **CASINO ROOM**

Presiding: Glen E. Edgerton, M. ASCE, Chairman, Executive Committee, Waterways Division

2:00 Model Studies of APRA Harbor, Guam, M.I.

John Carr, Senior Research Engineer in charge of Harbor Laboratory, California Institute of Technology, and Lt. (jg) J. J. Healy, CEC, USN, Jun. M. ASCE, Bureau of Yards and Docks, Representative at the Harbor Laboratory.

Discussion

Robert Y. Hudson, Assoc. M. ASCE, Chief, Wave Section, Waterways Experiment Station, Vicksburg, Miss.

3:00 Lake Michigan Erosion Studies—Chicago Area

John R. Hardin, M. ASCE, Division Engineer, Great Lakes Division, Corps of Engineers, Chicago, Ill.

Surveying and Mapping Division

2:00 P.M. **GOLD ROOM**

Presiding: H. W. Hemple, M. ASCE, Chairman, Executive Committee, Surveying and Mapping Division

2:00 The Uses of Photogrammetry in the Design of Highway Improvements

FRANK J. WILLIAMS, Assoc. M. ASCE, Gannett Fleming Corddry & Carpenter, Inc., Harrisburg, Pa.

2:45 Characteristics and Applications of the Transition Spiral Curve

C. C. Wiley, M. ASCE, Professor of Civil Engineering, University of Illinois.

Discussion

G. M. MAGEE, Engineer of Research, Association of American Railroads.

3:30 Datum Planes in Illinois

J. C. MCKIBBIN, Division of Waterways, State of Illinois, Springfield, Ill.

Discussion

W. T. LAIDLY, Chief of Engineering Operations Branch, U.S. Lake Survey, Detroit, Mich.

Local Sections Conference

Monday and Tuesday—October 9 and 10, 9:30 a.m., Congress Hotel

Representatives of Local Sections of ASCE in the central area of the United States will convene at the Congress Hotel on the Monday and Tuesday preceding this Annual Meeting.

This conference, which is primarily for appointed delegates of selected Sections, will be open to any and all who may be interested in the activities and operational details of ASCE Local Sections.

National Council of State Boards of Engineering Examiners

ANNUAL MEETING

The 30th Anniversary Meeting of the National Council of State Boards of Engineering Examiners will be held in Chicago at the Congress Hotel on October 9, 10, and 11, Monday through Wednesday of the meeting week. Dates and programs of the Council have been arranged for the convenience of those who wish to attend both NCSBEE and ASCE functions.

Members of ASCE are invited to attend the banquet of NCSBEE on Tuesday evening, October 10. Tickets will be available at the NCSBEE registration desk in the Congress Hotel.

Annual Meeting Ladies Program

Wednesday, October 11

Ladies will want to attend the Annual Meeting in the morning and the Membership Luncheon at noon. In the afternoon, the Walnut Room of the Congress Hotel will be headquarters for bridge and canasta contests. The evening will feature the Dinner-Dance.

Thursday, October 12, 3:30 p.m.

Tour of Chicago's North Shore, with dinner at the Edgewater Beach Hotel and entertainment by Celeste Carlyle.

Friday, October 13, 11:00 a.m.

Visit to Museum of Science and Industry with luncheon at the Hotel Windemere East, and a book review by Mrs. Virginia Upham.

Central U.S. Faculty Advisers Conference

Thursday, October 12, 9:30 a.m.

PINE ROOM **CONGRESS HOTEL**

All Student Chapter Faculty Advisers, Contact Members, or others especially interested in the activities and operational details of ASCE Student Chapters are invited to take part in this round-table discussion of student affairs.

Hotel Accommodations and Headquarters

Make Hotel Reservations Early.

The Congress Hotel in Chicago is the headquarters of this Annual Meeting of ASCE. Most events, unless otherwise noted, will be held in this hotel. All those planning to attend this convention are urged to make requests for reservation of hotel accommodations as early as possible. A block of rooms has been set aside at the Congress Hotel for ASCE. Late reservations will have to be assigned to other Chicago hotels.

Requests should be received by the Hotel and Registration Committee before September 20. Mail all requests to:

c/o Reservation Department
Congress Hotel
Michigan Avenue at Congress
Chicago 5, Ill.

Requests should mention your attendance at the ASCE convention. A special request form is printed on page 84 of this issue for your convenience.

TYPICAL CONGRESS HOTEL RATES

Single	Double
$5.00 and up	$7.50 and up

Central U.S. Student Chapter Conference

Thursday, October 12, 2 p.m.

PINE ROOM **CONGRESS HOTEL**

Students are invited to take part in all events of the Annual Meeting. However, a special luncheon for students has been arranged for Thursday, October 12. The conference will be held following the luncheon. Student papers and prizes will be presented. DEAN HARRY CURTIS, Director of the Tennessee Valley Authority and formerly Dean of Engineering at the University of Missouri, will deliver the principal address.

Annual Meeting Excursions

SATURDAY, OCTOBER 14

Trip No. 1. Leaves Congress Hotel at 9:00 a.m., proceeds to Bataan-Corregidor Memorial Bridge and then to Wisconsin Steel Works.

Trip No. 2. Leaves Congress Hotel at 9:15 a.m., proceeds to Chicago's South District Filtration Plant, makes a stop for lunch, and then proceeds to West-Southwest Sewage Treatment Works.

Trip No. 3. Leaves Congress Hotel at 9:30 a.m. Proceeds to Bataan-Corregidor Memorial Bridge and then to Portland Cement Association Laboratory in Skokie.

An excursion will be made to Sinclair Oil Refinery in East Chicago and laboratory in Harvey, if there is a demand for this trip.

Other tours to construction projects and radio and television studios will be arranged if Members and their guests so desire.

Chicago has much to offer the visitor who finds time to do a little sightseeing.

Annual Meeting Committees

NATHAN B. BIEDERMAN, *General Chairman*

LOUIS R. HOWSON, *Director, District 8*

Technical Program Committee
A. L. R. Sanders, Chairman

Hotel and Registration Committee
Howard F. Peckworth, Chairman

Entertainment Committee
E. Montford Fucik, Chairman

Excursion Committee
George I. Uitti, Chairman

Student Activities Committee
J. C. Chatterton, Chairman

Ladies Activities Committee
Mrs. L. R. Howson, Chairman

Publicity Committee
Harry F. Thomson, Chairman

Finance Committee
John J. Kearney, Chairman

Reception Committee
Charles B. Burdick, Chairman

SOCIETY NEWS

For Proceedings Abstracts and Order Blank, See Pages 109 and 110

Centennial of Engineering, 1952, Inc., Is Headed by Lenox R. Lohr

PLANS UNDER WAY to celebrate the ASCE Centennial of Engineering in Chicago in 1952 were announced by the Board of Direction at its Toronto Meeting. "The project will provide opportunity for American industry to emphasize its contributions to the advancement of civilization and to pay tribute to the free enterprise system that has made this progress possible." In addition to civil engineering, the celebration will include the entire engineering field, with the other societies joining forces to produce an event of international significance.

Maj. Lenox R. Lohr, M. ASCE, president of the Chicago Museum of Science and Industry, has been elected president of the not-for-profit corporation, Centennial of Engineering, 1952, Inc., which has been set up to carry out the project and direct the over-all activities connected with it. His aid was sought because of his experience as general manager of "A Century of Progress," the Chicago World's Fair of 1933 and 1934, and as president of the Chicago Railroad Fair of 1948 and 1949.

The celebration, including an exposition and a convocation of engineers, will occupy the approximate period, July 1 to September 30, 1952, and will be centered in the Museum of Science and Industry in Jackson Park, Chicago. Already housing the world's greatest collection of industrial and science exhibits, the museum is ideally adapted to the objectives of the celebration.

MAJ. LENOX R. LOHR
President, Centennial of Engineering, Inc., 1952

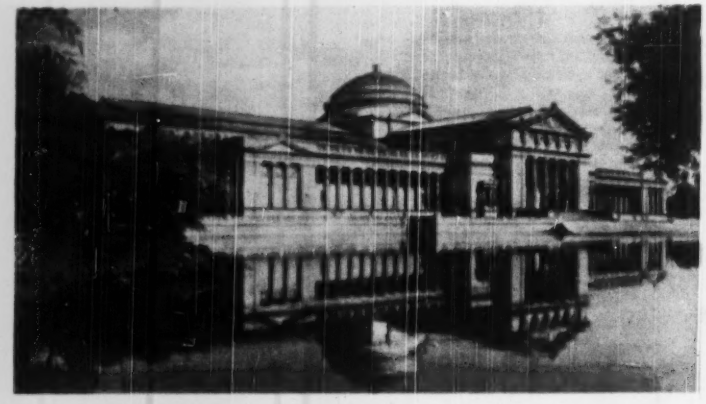
According to preliminary plans, the observance will consist of a variety of activities for both the general public and the professional engineer. Opening in early June will be a new permanent educational exhibit installation designed to bring home to visitors the tremendous contributions made by engineering during the past 100 years to the development of the nation and the elevation of the American standard of living. There will be appropriate temporary exhibits by engineering and industrial firms. A stage production, opening at the same time, will be presented several times daily during the remainder of the summer. A dynamic show of high entertainment value, the production will utilize a great variety of full-size equipment in telling the human interest story of technical advancement.

The greatest convocation of the engineering profession ever held is scheduled to take place between September 3 and 13. Each of the other EJC constituent societies has accepted an invitation to unite with ASCE in the Centennial Celebration, each planning to hold a full-scale meeting during the convocation period. The American Institute of Architects and the Engineering Institute of Canada already have taken formal action to participate. Nearly a hundred other national, international, and regional engineering societies will take part, as will the great engineering schools. The Department of State has stated its intention of collaborating with the Centennial in arranging for participation of foreign and international engineering organizations. Assurance of sufficient facilities to handle the large number of participants is given by the Chicago Convention Bureau.

Each participating society will arrange and finance its own program in coordination with the others, while Centennial of Engineering, 1952, Inc., will be responsible for the exposition and for general coordination of other activities.

Coordinated regional programs in all parts of the country will provide an opportunity for local groups of the engineering societies to bring the Centennial observation to their communities.

Plans for the international observance were made at a recent meeting in New



ASCE CENTENNIAL CELEBRATION will be centered in Chicago Museum of Science and Industry, which is internationally famed for its industrial and scientific exhibitions. Front of building faces park and rear, shown here, is on lagoon.

York, attended by representatives of the Founder Societies. In addressing the group, Major Lohr stated, "Engineers comprise about three-tenths of one percent of the 150,000,000 people in the United States. Probably no other group has contributed more toward developing the resources of the country, and bringing our standard of living to a level never before approached, than engineers. Yet—most of the other ninety-nine and seven-tenths percent have little, if any, realization of that fact. To the public mind, a veil of mystery clouds understanding of engineering principles, methods, and accomplishment . . . . Our citizens do not know to what extent the welfare of our nation in peace and its salvation in war depend upon the accumulated and continuing results of engineering research and its application.

"The year 1952 marks the centennial of the founding of the American Society of Civil Engineers, the oldest national engineering society in the country. As such, it affords an appropriate time for bringing to the public the full story of engineering achievement."

ASCE-AGC Joint Cooperative Committee Meets in Toronto

ONE OF THE most productive meetings of the Joint Cooperative Committee of ASCE and AGC since its organization two years ago was reported by its joint secretariat, Carl E. Beam for ASCE and A. N. Carter for AGC. Meeting in Toronto during the joint summer convention of ASCE and the Engineering Institute of Canada, the Joint Committee made the following recommendations.

1. Where graduate engineers are employed on construction in a responsible position either by contractor, owner, or the consulting engineer for the project, such experience should be counted by state registration boards toward an engineer's license.

2. The national staffs of both ASCE and AGC should continue to urge their respective Local Sections and Chapters to improve the civil engineering courses offered by engineering colleges and to help make the programs of the ASCE Student Chapters better.

3. The programs of assisting students to obtain employment on construction during summer has made progress. Whether the student upon graduation joins the staff of a consulting engineer on design work, secures employment in supervising construction, or works in some other phase of the industry, his construction experience will be beneficial.

4. Methods of attracting students into civil engineering courses will require the joint efforts of educators, consultants, engineers in both private and government employment, contractors, and manufacturers of construction equipment and supplies.

5. The establishment of regional cooperative committees by two California Local Sections of ASCE and two AGC Chapters met with approval.

6. Progress was reported on revising the "Standard Contract for Engineering Construction."

7. In the creation of toll bridge or toll highway commissions by state legislatures, adequate funds should be provided for engineering.

8. Better coordination and bid prices are obtained on building construction where each structure is awarded as one inclusive contract, rather than several separate contracts, such as for (*a*) structural frame, (*b*) plumbing, (*c*) heating work, and (*d*) electrical construction.

9. Negotiation by some public groups to reduce contractors' bids after sealed bids have been received is not favored. It is an undesirable procedure that presents major disadvantages to the owner (the public) and the contracting industry alike.

10. The penalty on small construction projects for extending the specified completion date or time should be stated in the specifications as a definite daily amount, rather than expressed in terms of the engineering costs during any additional time required.

The next meeting of the Joint Committee was set for Houston, Tex., as part of the ASCE spring meeting in February 1951.

ASCE Hydraulics Division Furthers Meeting Plans

UNDER THE DIRECTION of Sydney W. Chandler, president of the Jackson Branch of the Mid-South Section, local arrangements for the meeting of the Hydraulics Division at Jackson, Miss., November 1–3, are rapidly shaping up. Headquarters for the meeting will be the Heidelberg Hotel. The Jackson Chamber of Commerce is cooperating with the local committee and will mail literature and programs for the meeting to Division members about a month before the meeting.

A special feature of the technical program, scheduled for November 1 and 2, will be a symposium on Analog Computers and Experiments in Hydraulic Engineering. Analogs are a relatively new subject for civil engineering problems, and the symposium will bring together for the first time a complete presentation of the subject. This program has been arranged by the Fluid Mechanics Committee, of which Dr. Arthur Ippen is chairman. Another program feature will be the projection of three-dimensional color photographs to accompany a paper by J. W. Terry, U.S. Geological Survey, on "New Methods of Peak Flow Determinations."

Illinois Section Members Plan ASCE Chicago Meeting

COMMITTEE IN CHARGE of Chicago Meeting of Society, to be held at Congress Hotel, October 11–14, discusses plans with Executive Secretary Wm. N. Carey. Seated, left to right, are N. B. Bederman, chairman, 1950 convention committee; Secretary Carey; the late O. K. Jelinek, president, Illinois Section; and H. F. Thomson, chairman of committee in charge of publicity. Standing, in same order, are George Vitti, E. M. Fucik, Howard F. Peckworth, and H. F. Sommerschield. Mr. Jelinek's sudden death in Brussels, Belgium, on August 17, is reported elsewhere in this issue.

The audience will wear special polarized glasses to view the slide projections.

ASCE Honorary Member Boris A. Bakhmeteff will be the principal speaker at the Division banquet on November 2. Others on the banquet program include President Ernest E. Howard and President-Elect Gail A. Hathaway. November 3 will be devoted to a trip to the Vicksburg and Clinton laboratories of the Waterways Experiment Station.

Assisting Mr. Chandler in making local arrangements for the meeting are H. S. Gladfelter and H. G. Dewey, president and secretary-treasurer of the Mid-South Section.

Board Recommends Procedure for Obtaining Professional Engineering Services

SUGGESTED PROCEDURES FOR securing professional engineering services by public authorities—prepared jointly by the ASCE Committee on Professional Conduct and the Committee on Private Engineering Practice—were recommended by the Board of Direction at its Toronto meeting on July 10. The recommended procedures follow:

"*A*. The employer should always maintain his position so that he will be free to select his engineer, like his doctor or lawyer, on the basis of qualifications, mutual respect and confidence.

"*B*. Where the owner has had no prior association with engineers, qualified for the type of work involved, the following procedure is recommended:

"1. From a list of engineers recommended by qualified sources such as other employers or engineering societies, select one or more engineers to be interviewed.

"2. Determine which one of the engineers is best qualified for the particular engagement under consideration.

"3. Negotiate with the engineer so selected for services of the nature and extent required.

"4. The reasonableness of fees to be charged may be checked with the sources of the lists considered under 1, above.

"5. Engagements involving preliminary investigations and reports should commit the engineer to limiting fees in case complete engineering services are required at a later date.

"Engineering services should no more be sought on price competition than the services of a doctor or a lawyer.

"The cost of engineering services is very small compared to the over-all cost of any project. The economy of initial cost and future operation lies in the engineering conception and design; therefore, the engineer best qualified for the particular service is the best from every standpoint, regardless of engineering fees."

Engineers to Advise Civil Service Commission

AT THE SUGGESTION of Engineers Joint Council and in accordance with the wishes of the U.S. Civil Service Commission, an Advisory Committee on Engineering has been established by the Commission to advise on policies and practices related to the work of its Personnel Classification Division and its Examining and Placement Division.

The committee consists of ASCE Past-President Ezra B. Whitman, consulting engineer of Baltimore; Joseph H. Ehlers, ASCE Field Representative, Washington, D.C.; Blake R. Van Leer, president, Georgia School of Technology; Edwin O. Griffenhagen, M. ASCE, consulting engineer of Chicago; James B. Forrester, chairman, Department of Mining Engineering, Missouri School of Mines; and Leslie N. McClellan, M. ASCE, chief engineer, U.S. Bureau of Reclamation, Denver. Contact representative for the Commission on the committee will be Ernest J. Stocking, M. ASCE, assistant chief of the Examining and Placement Division.

Objectives of the committee are stated as follows:

1. To recommend to the Classification Division and to the Examining and Placement Division changes in practices, policies, or procedures which it is believed will place the recruitment, placement, and development of engineering personnel on a sounder basis.

2. To explore with the Commission implications of major changes in the field of personnel administration, as they affect professional engineers and related types of personnel.

3. To advise the Commission on programs and plans designed to improve Federal Personnel Administration of engineering personnel through a better understanding on the part of officials, employees and citizens of the problems and purposes of the Federal government's merit system.

4. To advise the Commission's two divisions previously mentioned in the determination of policies and programs for filling adequately key engineering positions, and with the problems of bringing into and keeping in the Federal service the type of engineers which it must have if its work is to be performed efficiently.

5. To assist the two divisions in their efforts to develop programs designed to improve the competence of administrative and supervisory personnel dealings with engineers and associated employees.

6. To provide the Commission with objective appraisals as to the effectiveness of the operations of the Examining and Placement Division and of the Personnel Classification Division so far as they affect the recruitment, placement, promotion, retention and development of engineering personnel in the Federal service.

Survey of Engineering Personnel Completed

ENGINEERS WHO RETURNED information for the Engineers Joint Council "Survey of Selected Engineering Personnel" regarding their qualifications and skills for use in a national emergency, will be gratified to know that the survey has been completed. The data—64,000 personnel records, microfilmed and transferred to IBM punch cards—are now deposited in the Office of Manpower, National Scientific Register, National Security Resources Board. With these personnel data, the EJC Survey Committee furnished approved definitions of 253 fields of specialization covering engineering.

Originally intended as a source file for engineers skilled in research and development, the survey was expanded to include all professional engineers. In obtaining this list, the government sought the cooperation of the professional societies. Under the sponsorship of EJC, the American Society of Mechanical Engineers entered into a contract with the Office of Naval Research in May 1949 to compile the master list of the professional engineers represented in the following 18 cooperating societies:

American Institute of Chemical Engineers
American Institute of Electrical Engineers
American Institute of Mining and Metallurgical Engineers
American Society of Civil Engineers
American Society of Heating and Ventilating Engineers
American Society of Mechanical Engineers
American Society for Metals
American Society of Refrigerating Engineers
Electrochemical Society
Institute of Aeronautical Sciences
Institute of Ceramic Engineers
Illuminating Engineering Society
Institute of Radio Engineers
National Society of Professional Engineers
Society of Automotive Engineers
Society of Economic Geologists
Society of Exploration Geophysicists
Society of Naval Architects and Marine Engineers

The Survey Committee, of which C. E. Davies, Secretary of ASME, is chairman, is composed of the secretaries of the five EJC constituent societies. The Director of the Survey for EJC is R. A. Wentworth.

Society Members in Maine Form Local Section

THE ACTIVE COOPERATION of the Society and of New England Sections was pledged the newly formed Maine Local Section at its installation dinner meeting by ASCE President Ernest E. Howard and other Society officers. Aiding President Howard in the installation ceremonies, which took place at the Worster House in Hallowell on August 7, were ASCE Vice-President Albert Haertlein, of Cambridge, and Director Harold L. Blakeslee, of New Haven. Both offered their good offices and aid in the development of future Section programs. Attendance at the dinner, in addition to Society officials, included 69 members of the Section and their wives.

A business meeting for the election of Section officers is scheduled to be held on September 30 at the Augusta House in Augusta.

Neal McDowell, highway engineer for the U.S. Bureau of Public Roads at Augusta, and Dr. Hamilton Gray, professor of civil engineering at the University of Maine, have headed efforts among Maine civil engineers, begun 15 years ago, for formation of a Section. Establishment of the Maine Section brings to 71 the roster of Society Local Sections.

OFFICIALS ATTENDING INAUGURATION OF Maine Local Section and their wives are shown at installation dinner meeting in Hallowell. The ladies (reading left to right) are Mrs. Harold L. Blakeslee, Mrs. Neal D. McDowell, Mrs. Ernest E. Howard, and Mrs. Hamilton Gray. Standing behind them are Harold L. Blakeslee, ASCE Director; Prof. Weston S. Evans, University of Maine; Neal D. McDowell, chairman, Maine Section; President Howard; Albert Haertlein, ASCE Vice-President; and Prof. Hamilton Gray, University of Maine.

ASCE Adds 195 to Its Life Membership Rolls

Engineers Achieving Life Member Status on January 1, 1950, Are Listed

Edwin Learned Adams
Elmer Ellsworth Adams
George Norris Adams
Frank Monnon Aguirre
Raymond Glime Alexander
Gustaf Birger Andreen
Richard Allison Backus
Paul Bailey
Ned Duncan Baker
Frank Arthur Banks
Archer Fortescue Barnard
Ernest Ruby Bear
William Hatrick Becker
Edward Joseph Bednarski
John Arthur Beemer
Harry Montefiore Bergman
Milton Clark Blanchard
Clarence Earl Blee
Arthur Frederick Blight
Robert Lawton Bowen
Fred Drexel Bowlus
Harold Affleck Brainerd
John Henry Bringhurst
Elbert Calvin Brown
Percy Hiram Budd
George Howard Canfield
Selleck Townsend Mann Carpenter
Leland Clapper
Eviane Kemper Carter
Harry Lee Clarke
Denzil Worrell Coe
Patrick M. Corry
William Carey Cram, Jr.
Lynn Crandall
George Solomon Crites
Herman G. Crow
Royal William Davenport
Daniel Elias Davis
Meyer Davis
Thomas Charles Desmond
Arvin J. Dillenbeck
Edward Clarence Dohm
Guy Palmer Dorsey
Joseph Cummings Dort
Lott Davis Draper
Walter Hanson Dunlap
William Dyer
Glen Edgar Edgerton
George Garrett Edwards
Charles Raymond Ege
Rowland Leonard Egenhoff
John Arthur Elliott
John Hanson Ensey
James Lumsden Ferdbee
James Kip Finch
Francis Bonner Forbes
Ralph Forney Gallup
Roy Warner Gaustmann
Russell Verstille Glenn
Charles Goodman
Samuel Gordon
Fred Bacon Greenleaf
Charles Lacey Hall
Frederic Francis Hall
George Elias Halstead
Horace Parlin Hamlin
George Washington Hand
Burt Harmon
Phil B. Harris
Elmer Perkins Haw
Walter Leo Hempelmann
Ernest Demarest Hendricks
Charles Sumner Henning, Jr.
Frederick William Henriel
Clinton Seymour Herrick
Milton Hesselberger
Edward Augustus Clyde Hoge
Benjamin Oliver Hood
George William Howson
Russell Benjamin Huffman
Charles Reginald Hughes
Whitney Clark Huntington
Andrew P. Hustad
Selwyn Simon Jacobs
Henry Louis Jacques
Thomas McLean Jasper
Gunni Jeppesen
Fontaine Jones
Raymon Clinton Kellogg
John Martin Kemmerer
Karl Raymond Kennison
Arthur Dale Kidder
Arthur Caswell King
Wesley Eugene King
Jean Howard Knox
Louis Dietrich Koop
William Franklin Krahl
Karl Barclay Kumpe
Albert L. Larsen
Claude Milton Lambe
Clyde Emerson Learned
Clifford Stone Leet
Word Leigh
James Fulton Leonard
Robert MacMinn
Rossiter Magers McCrone
David F. McCurrach
Francis B. Matun
Harold Henry Marsh
Richard Coke Marshall, Jr.
Horatio Seymour Mattimore
Ferdinand Northrup Menefee
Albert Arthur Miller
Guttorm Miller
Loyola Leonard Mills
William Stanton Monroe
William Gerald Moore
Roger Leroy Morrison
David Campsey Morrow
Harrie Langdon Muchemore
Lee Orlo Murphy
Jabez Curry Nelson
George Alexander Noren
Leonard Drake Norsworthy
Sidney Robert Okes
Manley Osgood
Charles Ernest Pett
Benjamin Simpson Philbrick
Albert Fredrick Porzelius
Theodore Dudley Pratt
Asa Glisson Proctor
Homer Puckett
Ray Stevens Quick*
John Ignatius Quinn
Erskine Ramsay
Arthur Nelson Reece
Henry George Reitz
Leon Benedict Reynolds
Ralph Farnham Rhodes
George Allen Ridgeway
Herbert Spencer Ripley
Jesse Steele Ritchey
Frederick Thurston Robson
Henry Nathan Rodenbaugh
Andrew Peach Rollins
Paul Francis Rossell
Ernest Carl Rusbasm
Frank Alden Russell
George Edmond Russell
Charles Boone Sadler
Walter Samans
Charles Adrian Sawyer, Jr.
Maurice Roos Scharff
Frederick E Schmitt
Leon Monroe Schoonmaker
Howard Daniel Severance
Horatio Seymour
Clark Hervey Shaw
Edward Gwyn Sheibley*
Lawrence Vinnedge Sheridan
Arthur Louis Sherman
Wilson Sidwell
Norwood Silsbee
Arthur Philip Skaer
Joseph Wilson Smith
Leroy Clarke Smith
Reynolds Belden Smith
Harry Seel Stanton
John Stearns
David Barnard Steinman
Thomas Henry Strate
Harold Warner Streeter
Richards Merle Strohl
Carl Stuetzel, Jr.
Nathan Henry Sturdy
Douglas Clifton Tabor
James Cod Terry
Oscar Gewen Thurlow
Nathan Newton Tiffany
John Wilson Toyne
Arthur John Turner
Richard Gaines Tyler
Charles Melville Upham
John Terrell Wawter
Lee Hamill Walker
Raymond Verner Warren
Willis Dow Feck Warren
Perry Allen Welty
Barclay White
Philip Sheridan Wickerham
Ernest Clifford Willard
Charles A. Winston
Reinhold Bertram Wolff
Dana Melvin Wood
Harold Ira Wood
Clarence Richard Young

* *Deceased*

Board Studies Proposed Change in Code of Ethics

THE BOARD OF DIRECTION reviewed a proposed change in Article 9 of the Code of Ethics, submitted by the ASCE Committee on Professional Conduct, at its Toronto meeting. The proposed substitute wording would be from, "To act in any manner or engage in any practice which will tend to bring discredit on the honor or dignity of the engineering profession," to:

"To use undue influence, or offer commissions or otherwise improperly solicit professional work directly or indirectly."

The Board voted to defer action on the proposed change until its October meeting in Chicago.

Complete copies of the revised Code of Ethics, adopted by the Board of Direction at its 1949 meeting in Washington, D.C., may be consulted in the January 1950 issue of CIVIL ENGINEERING (page 68) or in the Official Register for 1950 (page 6).

FROM THE NATION'S *Capital*

JOSEPH H. EHLERS, M. ASCE
Field Representative ASCE

EIGHT WEEKS OF military action in Korea have made it clearer that the United States must increase its military strength to clean up the Korean situation and step up its preparedness to meet possible armed aggression against other free nations elsewhere. These military requirements pose the economic problem of how they shall be fitted into our $270 billion rate of annual national production.

The President has asked Congress for $10½ billion additional appropriation to strengthen the armed forces and has given notice of further requests to come. Current thinking is that, short of all-out war, military expenditures will go up from the present $13 billion to $25 or $35 billion a year. During World War II annual military expenditures ran over $80 billion.

Legislation for Economic Controls

Economic controls legislation is taking definite form. Under the bill passed by the Senate on August 21, the President is authorized to invoke price and rationing controls, whenever he sees fit but must simultaneously invoke wage controls. The Senate bill now goes to a Senate-House conference to iron out differences with the House version passed by an overwhelming majority on August 11.

The House version of the economic controls bill—H.R. 9176—as finally passed, made wage-price-rationing powers discretionary with the President. He may require acceptance and priority fulfilment of all national defense contracts. He may requisition any materials or facilities. He may set up a system of priorities and allocations. He may make or guarantee loans up to $2 billion for defense operations. The President had asked for but did not get in either the Senate or House version authority to regulate real estate credit and commodity speculation.

A law along these general lines will probably be enacted before this issue appears.

Construction Materials Available

Civilian construction will be cut down in varying degrees because of tighter credit and shortages of materials. Curtailment of government construction projects will be dictated in many cases purely from motives of economy. How much will be cut from the government's record-size public works program is problematical. Hydroelectric power and highway construction probably will be little affected.

In respect to material shortages, a lesser curtailment will result than many anticipated. Take the case of structures requiring steel, for example. Out of our present capacity of 100,000,000 tons a year and a 6,000,000-ton plant expansion under way, military uses have recently been taking about 1,000,000 tons a year. This use could increase several fold without requiring drastic curtailment in construction involving steel.

It is estimated that the maximum productive capacity of the nation will permit getting under construction and manufacture $10 billion worth of military goods in the first year. This indicates an upper limit to the amount of steel that can be used by the military establishment. We have few ships to build, our cantonments are still in existence, and our industrial plants are developed practically to a wartime basis.

Lumber is usually a critical material in a situation such as the present, and between the material shortages and the credit restrictions new private housing developments will be hit. Some material suppliers believe they will be looking for customers rather than worrying about production problems.

Manpower Displacements

The Defense Department has not made known its needs for manpower, other than the 300,000 scheduled to be called to active duty by October 31 from the Reserves, the National Guard, and Selective Service. Unofficial guesses are that during the next two-year period and short of all-out war, 2,500,000 reservists and 500,000 selectees will be added to the 1,500,000 now in uniform. The Secretary of Defense has recommended to Congress Universal Military Training for ages 17 to 20. The Army is planning to reopen a number of training camps; there are indications that additional National Guard and Reserve Units will be called; and inactive Engineer Reserve Officers of company grade are being alerted to report to active duty.

The Secretary of Defense is expected soon to issue a statement relating the classification, recruitment, and allocation of scientists and specialists including engineers. The Labor Department's list of critical occupations includes civil, electrical and sanitary engineers.

ASCE Officially Offers Its Services

Early in August President Howard and Past-President Thomas visited Washington. They had a conference with the Secretary of the Interior covering various topics of interest. The EJC Water Policy Statement was discussed with officials of the Bureau of the Budget. A conference was also held with the Acting Administrator of the Point IV Program. At each of these conferences, the assistance that ASCE and EJC might render was explained to the government officials.

Engineer-Architect Functions Reviewed

Conferences are currently being held, both in Washington and New York, concerning the appropriate division of and responsibility for defense design and construction supervision among the various engineering and architectural groups. The policy statement made early in World War II, dealing with the respective functions of engineers, architects and other professional men in connection with defense housing, will be reviewed. The situation with respect to other fields of construction relating to emergency defense is likewise being studied.

Washington, D.C.
August 22, 1950

ASCE ANNUAL MEETING—CHICAGO

"The Board of Direction hereby declares that exceptional circumstances exist with regard to the Annual Meeting of the Society, required under the Constitution of the Society to be held in October 1950, and it is Resolved: That, under Article VIII, Section 1, of the Constitution, the Board of Direction hereby assigns October 11, 1950, as the date, and Chicago, Illinois, as the place of the Annual Meeting of the Society for October 1950, and instructs the Executive Secretary, through notices in 'Civil Engineering,' to give the membership due and timely notice of the date and place of said Annual Meeting."

ASCE MEMBERSHIP AS OF AUGUST 9, 1950

Members	7,713
Associate Members	9,915
Junior Members	11,600
Honorary Members	39
Affiliates	72
Fellows	1
Total	29,340
(August 9, 1949	26,261)

"In Case of FIRE..."

In case of fire, what would your plant's chances be? Would a blaze go unchecked . . . or would adequate fire protection equipment keep it under control?

Unfortunately, too many people responsible for fire protection rely solely on fireproof building construction and eliminating ordinary fire hazards. Important as these two precautions are, they shouldn't be the only ones. Remember . . . a dependable water supply system backed by sufficient pressure is just as essential.

Switzer-Cummins considered this when they recently installed a 100,000 gallon Horton Watersphere at their Indianapolis plant. The new streamlined tank is connected directly to 3300 sprinkler heads for immediate and dependable action. Gravity pressure sees to that. As a result of this added fire protection, Switzer-Cummins has been able to substantially reduce its fire insurance costs—an important consideration whenever new plant facilities are being planned.

Horton Waterspheres are built in capacities from 25,000 to 250,000 gallons, in any height to bottom required. Our nearest office will be glad to furnish estimating data for your next job calling for dependable water supply. When requesting quotations, state capacity, height to the low water line, location and type of insurance carried.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3	2167 Healey Bldg.	Detroit 26	1541 Lafayette Bldg.
Birmingham 1	1596 N. Fiftieth St.	Havana	402 Abreu Bldg.
Boston 10	1009—201 Devonshire St.	Houston 2	2128 National Standard Bldg.
Chicago 4	2199 McCormick Bldg.	Los Angeles 14	1556 General Petroleum Bldg.
Cleveland 15	2263 Guildhall Bldg.	New York 6	3395—165 Broadway Bldg.
Philadelphia 3	1652—1700 Walnut St. Bldg.		
Salt Lake City 1	509 West 17th South St.		
San Francisco 4	1584—200 Bush St.		
Seattle 1	1309 Henry Bldg.		
Tulsa 3	1647 Hunt Bldg.		

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

District 9 Council Is Organized in Dayton

ATTENDING TWO-DAY ORGANIZATIONAL MEETING of District 9 Council in Dayton, Ohio, are (seated, left to right) D. V. Terrell, dean of engineering at University of Kentucky and presiding officer; L. S. Finch, chief engineer, Indianapolis Water Co., and newly elected Council chairman; and C. R. Dole, civil engineer, Dayton Power & Light Co., and secretary of Council. Standing are E. Lawrence Chandler, Assistant Secretary of ASCE, New York, and ASCE Director G. Brooks Earnest, professor of engineering and surveying at Case Institute of Technology. Mr. Chandler discussed the Council's opportunities to bring ASCE closer to the membership and to make the Society a greater force in District 9. District 9 Council will hold its first meeting at Clifty Falls, Ind., on September 30 during joint meeting of Indiana and Kentucky Sections. Full-fledged District meeting will be held as joint session of Society's summer convention in Louisville, Ky., June 11 and 12, 1951.

Daniel W. Mead Prize Subject Is Announced

THIS YEAR'S CONTESTANTS for the Daniel W. Mead Prizes for Junior and Student Chapter members will write on the subject, "Why Is a Code of Professional Ethics Desirable," according to an announcement of the ASCE Committee on Professional Conduct made at the Toronto meeting of the Board of Direction. All entries must reach the Executive Secretary of ASCE by June 1, 1951.

Established in 1939 by the late Daniel W. Mead, Past-President and Honorary Member of ASCE, the Daniel W. Mead Awards consist of a Junior prize of $50 in cash and a certificate, and a Student prize of $25 and a certificate.

ASCE Committee Studies Runway Design Procedure

PROBLEMS INVOLVED IN the design of airports were discussed at a recent meeting of the Committee on Correlation of Runway Design Procedures of the ASCE Air Transport Division in Denver. After formulating the scope of its work and planning its program for the coming year, the group visited the Bureau of Reclamation laboratories in Denver.

Committee members attending the meeting were Walter Johannessen, Phoenix, Ariz., consultant, chairman; Henry Aaron, Civil Aeronautics Administration; Harold Allen, Bureau of Public Roads; Gerald Pickett, Kansas State College; Robert Horonjeff, University of California, secretary; and Alfred J. Ryan, Denver consultant.

University of Utah Student Chapter Is Honored

STUDENT CHAPTER MEMBERS AT UNIVERSITY OF UTAH proudly point to broom flying from roof of Civil Engineering Building and signifying that the Civils have made a clean sweep of engineering activities for the year. Happy over winning trophies in both technical and extra-curricular events sponsored by the College of Engineering Council are, left to right: Hop Ensign, secretary of ASCE Student Chapter; Tom Dodds, committee member; Bob Brandon, publicity committee chairman; and Vyrl Goff, Student Chapter president. Final and most spectacular event won by group was Engineering Open House Display, in which Civil Engineering Department exhibited actual working model of sewage-treatment plant for town of 3,000. Complete with operating valves, scrapers, and pumps, model was built by Grant K. Borg, Assoc. M. ASCE, instructor in department.

Six comparative cost estimates prove . . . **reinforced concrete** is the

Lowest-cost

fire-safe construction

FOR THE NEW

University of Wisconsin

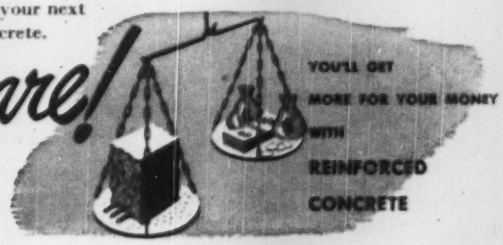
ATHLETIC BUILDING

ENGINEERS: Ammann & Whitney;
Roger C. Kirchhoff, Wisconsin State Architect

And . . . reduces erection time of 400-ft barrel

This handsome athletic practice building, now under construction at the University of Wisconsin, has a barrel shell concrete roof covering a clear span of 200 x 400 feet. In designing this structure, New York engineers, Ammann and Whitney, made a comparative cost study of six methods of roof construction. Their verdict: "Reinforced concrete is the cheapest fire-resisting construction which can be used for this building . . . we recommend its use." Reinforced concrete is not only a lower-cost material for building frames and roofs—it has many other advantages. It provides a rugged, durable monolith that is inherently fire-safe, as well as highly resistant to wind, shock, and quakes. Equally important, it requires less time to erect. Reinforcing bars, cement, and aggregate are readily available. On your next building, it will pay you to consider reinforced concrete.

Compare!



CONCRETE REINFORCING STEEL INSTITUTE
38 S. Dearborn St.,
Chicago 3, Illinois

Coming Local Section Events

Alabama—All-day meeting including inspection trip and dinner at Battle House, Mobile, Ala., September 15, at 9 a.m.

Cincinnati—Joint week-end meeting with the Kentucky and Indiana Sections at Clifty Falls State Park, Madison, Ind., September 30 and October 1.

Colorado—Dinner meeting the second Monday of every month at 6:30 p.m.; technical meeting at 8 p.m. Section luncheons every Wednesday at Daniels & Fishers Department Store at 12 noon. Soil Mechanics and Foundations, Hydraulics, Structural, and Irrigation Division of the Section meet monthly on the first Monday, the first Tuesday, the third Thursday, and the fourth Monday, respectively.

Indiana—Joint meeting with the Cincinnati and Kentucky Sections at Clifty Falls State Park, Madison, Ind., September 30 and October 1.

Kentucky—Joint week-end meeting with the Cincinnati and Indiana Sections at Clifty Falls State Park, Madison, Ind., September 30 and October 1.

Los Angeles—Dinner meeting at the Alexandria Hotel, Los Angeles, September 13, at 6:30 p.m., with Junior Forum meeting at 6 p.m. Meeting of the Sanitary Group of the Section at the Hotel Clark, Los Angeles, September 27, at 6 p.m. Seminar on construction practices at the California Institute of Technology, September 20, at 7:30 p.m.

Maine—Business meeting at the Augusta House, Augusta, on September 30. Newly established Section will elect its first officers.

Maryland—Meeting at the Engineers Club of Baltimore, Baltimore, October 11, at 8 p.m.; dinner at 7 p.m.

Pittsburgh—Inspection trip to the Greater Pittsburgh Airport on September 23.

Sacramento—Regular luncheon meetings every Tuesday at the Elks Club, Sacramento, at 12:30 p.m.

West Virginia—Fall meeting at the Wheeling Country Club, W.Va., October 20, at 6:30 p.m.

Scheduled ASCE Meetings

FALL MEETING

Chicago, Ill., October 11–14
(Board of Direction meets October 9–10)

SPRING CONVENTION

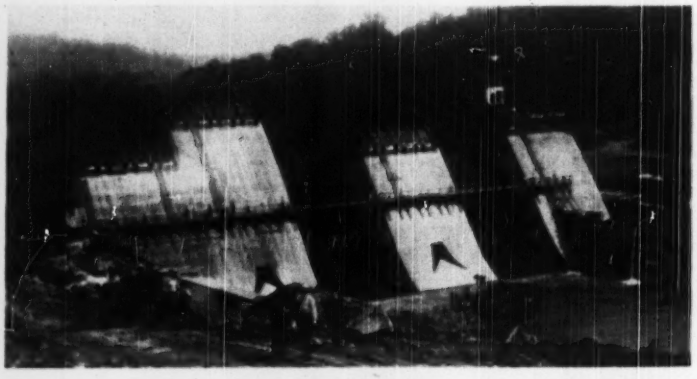
Houston, Tex., February 21–23
(Board of Direction meets February 19–20)

SUMMER MEETING

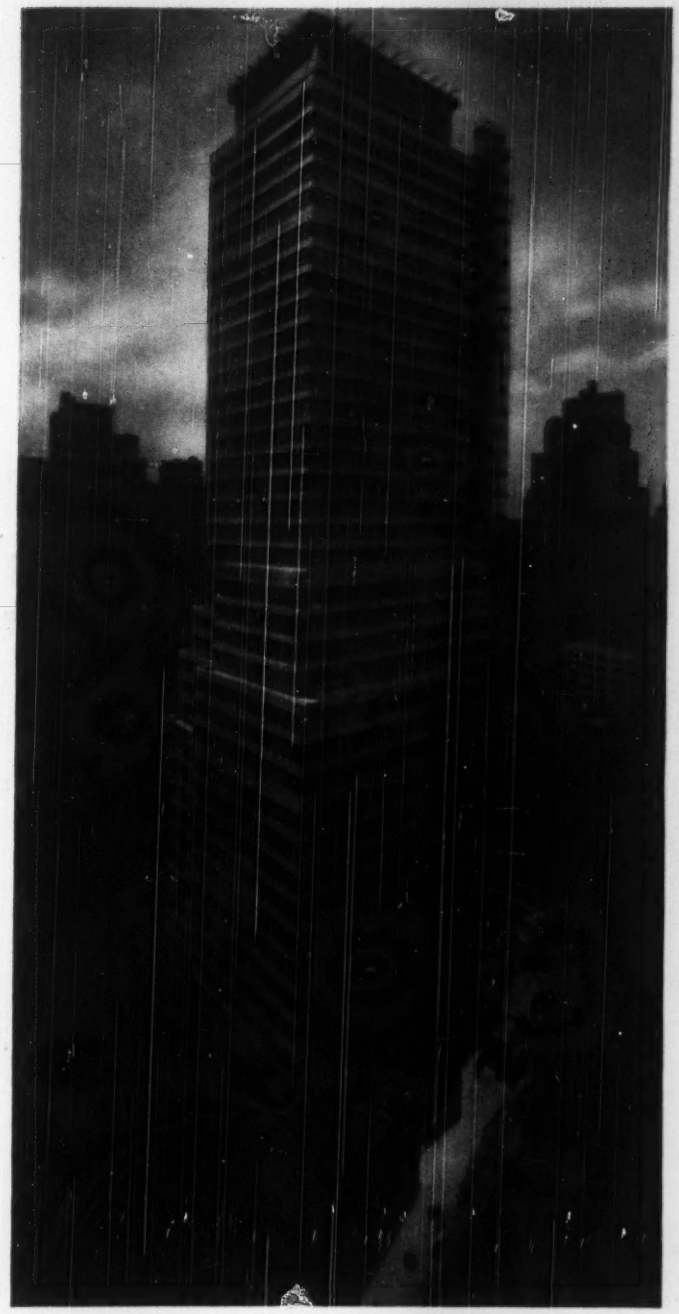
Louisville, Ky., June 13–15
(Board of Direction meets June 11–12)

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Buffalo	June 20	47	Luncheon meeting. A. B. Young, assistant director of research, Hydroelectric Power Commission of Ontario, Canada, spoke on "Quality Concrete"—its technical control as practiced by the Commission.
Duluth	June 19	15	Discussion of the revised constitution. Prof. Clarence D. Lindquist, head, department of engineering, University of Minnesota, Duluth, outlined cooperative work-study plan of mechanical engineering department.
Indiana	June 6	...	Dinner meeting with discussion of proposed reorganization of Surveying and Mapping Division.
Oklahoma			
Oklahoma City Branch	July 28	45	ASCE Director Robert B. Brooks, principal speaker of evening, discussed Society activities.
Sacramento	June 13	94	Traffic interchange design was described by Sam Helwer, assistant engineer of design, California State Division of Highways.
	June 20	105	Luncheon meeting with Norman E. Woodbury, personnel officer, California State Department of Corrections, speaking on "Practical Supervision."
San Diego	June 27	54	Dinner meeting. John Bate, port director, City of San Diego, Calif., discussed proposed Laguna Tunnel.
Southern Idaho	June 9	17	Dinner meeting. ASCE Director Walter J. Ryan spoke on Society affairs.
Spokane	June 16	...	Business meeting featuring James E. McGivern, dean of school of engineering, Gonzaga University, as speaker.
Tennessee Valley	July 7	22	Inspection tour of the Diamond Cement Co.'s plant in Seattle, Wash., which included a luncheon sponsored by Portland Cement Association.
Knoxville Sub-Section	June 14	44	Business meeting devoted to writing of petition for creation of Division of Applied Mechanics. S. Leary Jones, principal engineer of stream pollution, Tennessee Department of Public Health, concluded the program with a talk on stream pollution.
Muscle Shoals Sub-Section	June 15	13	Round-table discussion on Alabama's registration law.
Wisconsin	June 17	...	Inspection tour of new $3,000,000 research and development laboratory of Portland Cement Association at Skokie, Ill., and long-term exposure concrete test specimens at Naperville, Ill.



MORE THAN 90 MEMBERS OF PITTSBURGH SECTION and their guests visit construction site of Conemaugh Dam, near Saltsburg, Pa., on recent inspection tour of this new unit in flood-protection system for Pittsburgh area. Project is being built under supervision of Pittsburgh district of Corps of Engineers.



New Skyscraper in Times Square District

Known as "1407 Broadway," this new 42-story office-and-showroom building is the first skyscraper to be built in New York's Times Square District in 19 years.

The structure occupies the entire blockfront on Broadway, between 38th and 39th Streets, and also fronts on 7th Avenue. It is especially planned and designed to serve the women's apparel and textile industries. It is completely air-conditioned, has 1,000,000 sq ft of rentable space, and facilities for unloading as many as nine trailer trucks at one time. The ground floor is occupied by stores, and for the convenience of employees and passersby, a block-long arcade extends through the building from Broadway to 7th Avenue.

The exterior of 1407 Broadway is virtually a series of picture windows, separated between stories by a facing of sea-green brick. The steel framework, weighing close to 10,000 tons, was fabricated and erected by Bethlehem.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

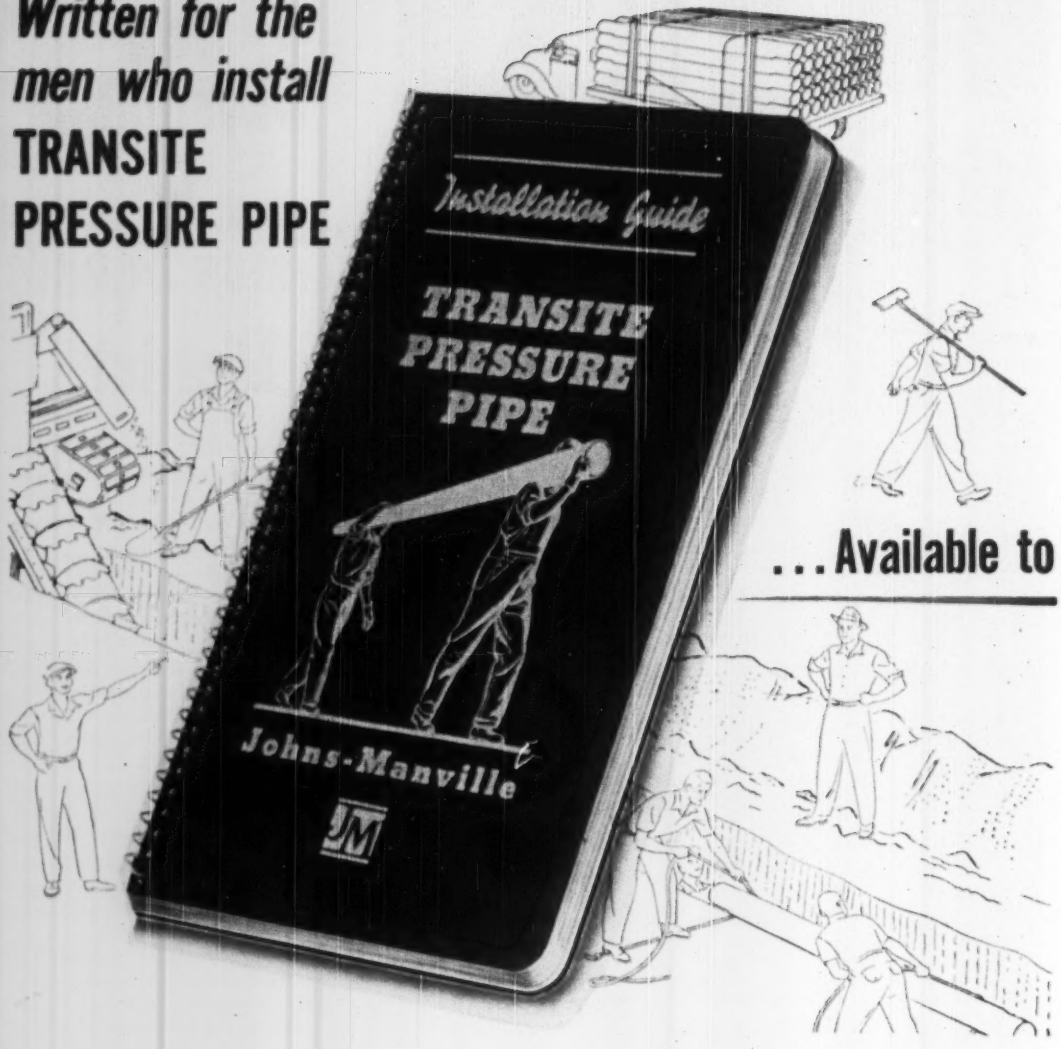
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation.

Owner: 1407 Broadway Realty Corp., New York. *Architects:* Kahn & Jacobs, New York. *Structural Engineer:* Charles Mayer, C. E., New York. *Contractor:* J. H. Taylor Construction Co., Inc., New York.

BETHLEHEM STEEL

FABRICATED STEEL CONSTRUCTION

Written for the men who install TRANSITE PRESSURE PIPE



. . . Available to

AS ITS TITLE IMPLIES, this new Installation Guide was designed especially for those who do the actual work of installing Transite* Pressure Pipe . . . a handy working tool intended to help the man in the field do a good job in an economical way.

But it answers so many questions of general interest about Transite Pipe that it is being offered, without cost, to anyone concerned with the design, construction or operation of a water system.

Send for your copy today. It will give you a new insight into Transite's many practical features that reduce water line installation costs . . . help answer some of the questions you may have about this Johns-Manville asbestos-cement pipe that is contributing to better and more economical water systems for thousands of American cities and towns.

*TRANSITE is a Johns-Manville registered trade mark

JOHNS MANVILLE JM PRODUCTS

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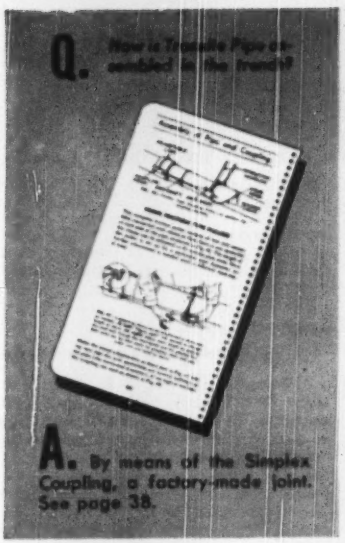
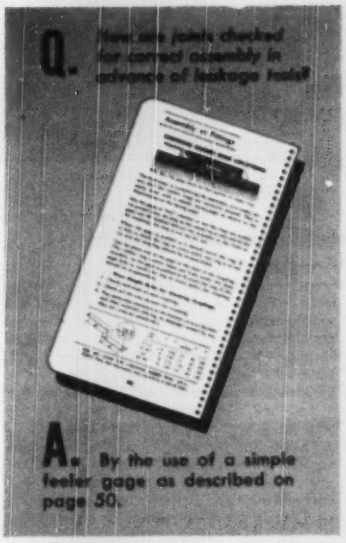
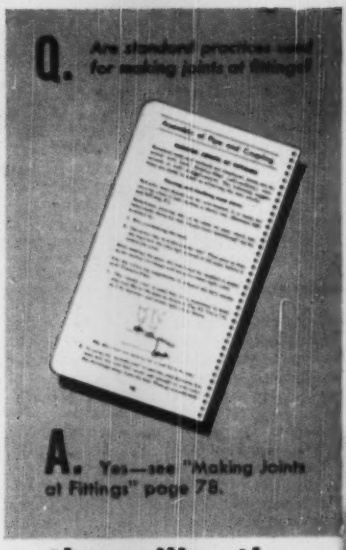
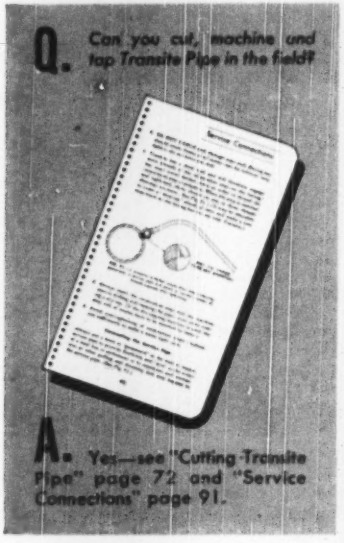
FOR BETTER

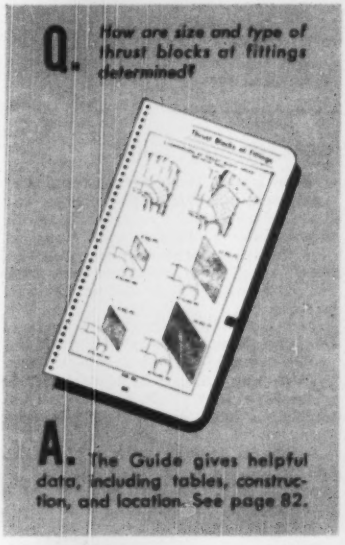


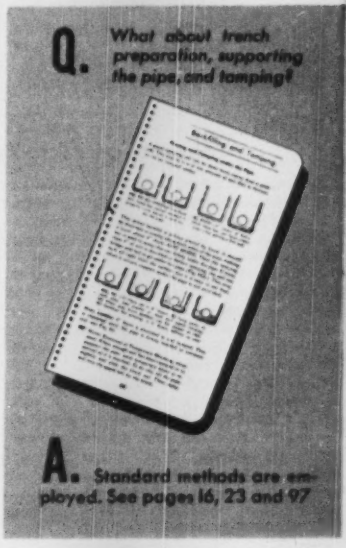

Q. How are joints checked for correct assembly in advance of leakage tests?
A. By the use of a simple feeler gage as described on page 50.



anyone who wants the answers to questions like these


Q. Can you cut, machine and tap Transite Pipe in the field?
A. Yes—see "Cutting Transite Pipe" page 72 and "Service Connections" page 91.


Q. How are size and type of thrust blocks at fittings determined?
A. The Guide gives helpful data, including tables, construction, and location. See page 82.



Just use the coupon—or write to Johns-Manville, Box 290, New York 16, N. Y. In Canada, address 199 Bay Street, Toronto, Ontario.

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Please send me the Transite Pipe Installation Guide (TR-62A).

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CE-9

ASBESTOS-CEMENT **PRESSURE PIPE**

WATER SERVICE

NEWS BRIEFS

Contractors and Government Agencies Confer on Defense Measures

WAYS OF MAKING most effective use of the general contracting industry in the current mobilization program were discussed by the Associated General Contractors Committee on National Defense and representatives of government agencies at a meeting in Washington on July 21. In a memorandum submitted to the government representatives, the AGC emphasized the importance of the joint discussion by pointing out that "prior to the start of World War II many experiments were tried before government agencies arrived at the policies that made it possible to mobilize the construction industry most effectively."

Stating that the capacity of general contractors to handle construction quickly and economically is greater than ever before, the AGC group promised that the industry "will be able to handle all construction required by prospective mobilization plans promptly and economically." At present the group sees ample contractor capacity for both civilian and government construction, but warns that "the materials shortages which have been developing may become more serious." Further committee recommendations call for the award of fixed price contracts, wherever possible, for defense construction in continental United States.

At the conclusion of the meeting, the representatives of government agencies responsible for the execution of defense construction recommended that the AGC Committee on National Defense keep in close contact with the agencies, and be available upon need for consultation on construction problems and policies. Pending passage of appropriation bills, no definite information could be given on the size of prospective defense programs.

The AGC Committee on National Defense consists of its current officers—Walter L. Couse, M. ASCE, president; G. W. Maxon, vice-president; and D. A. Harmon, N. K. Dickerson, Jr., and John MacLeod, division chairmen—and an advisory group of past-presidents.

Construction Activity Reaches New High

EXPENDITURES FOR NEW construction in July reached the unprecedented monthly total of more than $2.6 billion, according to preliminary estimates of the Construction Division of the Department of Commerce and the U.S. Labor Department's Bureau of Labor Statistics. The July figure represented an increase of 6 percent over the June level and of 25 percent over July 1949.

Total private construction for the month advanced more than seasonally to $1,900 million—6 percent above the June outlay and 32 percent above last July. Part of this advance is attributed to the large volume of housing construction that got under way during the month. Expenditures for new dwelling units, comprising 57 percent of all outlays for private construction, rose to $1,100 million, compared with $1,030 million in June and $650 million last July.

Continued expansion of new industrial plants during the month is also reported, the value of work put in place exceeding the July 1949 total by 15 percent. Increases over the past June and over July 1949 were similarly registered in the construction of warehouses, office and loft buildings, and stores, restaurants and garages. Construction of private hospitals advanced 76 percent over the corresponding month a year ago. On the other hand, outlays for both farms and public utilities declined from July 1949 levels.

Total public construction in July amounted to $693 million, largely as a result of a 10 percent increase in expenditures for highway construction. Substantial gains over July a year ago were recorded in educational and institutional buildings, and slight gains from June.

Figures for the first seven months of 1950, totaling $14.4 billion, registered a gain of 19 percent over the 1949 level, according to the joint agencies. Private construction outlays for the seven-month period amounted to almost $10.8 billion, surpassing last year's total for the corresponding period by 23 percent. Contributing to these expenditures are a 60 percent increase in housing and a 10 percent rise in public expenditures.

New Orleans to Prepare Plans for Civic Center

ENGINEERING STUDIES AND plans for an $8,550,000 civic center for New Orleans will be expedited by a planning advance of $420,000 recently approved by the Housing and Home Finance Agency. To be built on a 13-acre site that has been acquired by the city and cleared of old buildings, the project will include a city hall and related buildings and about 130,000 sq ft of below-street-level parking space.

The proposed city hall, which will consolidate various city departments now housed in inadequate separate buildings, will contain an estimated 338,000 sq ft of floor space. It will be built of steel frame and masonry construction on pile foundations.

Contract Let for Chief Joseph Dam Generators

A $4,277,000 CORPS of Engineers contract for construction of four 64,000-kw generators for the Chief Joseph Dam project on the Columbia River has been awarded to the Westinghouse Electric Corp. Installation of these initial units is scheduled for the end of 1954 and early 1955. The power house is designed for 27 water-wheel generators, each capable of producing 64,000 kw at 100 rpm.

Chief Joseph Dam (August issue, page 62) will be located on the Columbia River about 50 miles below Grand Coulee Dam and will supply power to the Pacific Northwest over the transmission system of the Bonneville Power Administration.

St. Louis Firm to Operate Big Air Force Test Center

THE U.S. Air FORCE has given to Aro, Inc., a subsidiary of the St. Louis engineering firm of Sverdrup & Parcel, the job of operating its $100,000,000 Arnold Engineering Development Center, under construction at Tullahoma, Tenn. Work at the center, which is scheduled to be in operation in 1952, will include testing jets, turbojets, and rockets at simulated altitudes up to 75,000 ft; operation of the largest supersonic wind tunnel in the country; and work on guided missiles at simulated speeds up to 7,500 mph.

Plans for design of the center were made by the Sverdrup & Parcel firm, which is headed by Leif John Sverdrup, M. ASCE.

Competition Is Open to Student Civil Engineers

TO STIMULATE ORIGINAL thinking in the design, fabrication, and use of concrete products, the Universal Concrete Pipe Co., Columbus, Ohio, has established three annual $500 prizes, which are open to senior civil engineering students in recognized colleges and universities east of the Mississippi. Papers must be submitted to the company by March 31, and announcement of winners will be made by May 15. Entries will be judged on the basis of originality of idea, practicality of the results, and technical competence of the presentation.

Complete details are given in a brochure that will be distributed to students at the start of the school year. Copies may be obtained earlier from the company.

Sewerage Authority Is Set Up in New Jersey

METHODS OF ELIMINATING the serious pollution of the Raritan River Valley in New Jersey will be studied under a recently created Middlesex County Sewerage Authority. The group of engineers, industrialists, and city officials will seek to resolve a two-year dispute over a recommendation of the County Planning Board for construction of a $26,000,000 trunk sewer for the Raritan River Valley.

Several communities in the Raritan Bay area oppose the trunk sewer in the belief that it will further pollute the waters of the bay. Recommendations of the County Planning Board for construction of the sewer were made on the basis of preliminary surveys by the Boston firm of Metcalf & Eddy and the Woods Hole (Mass.) Oceanographic Institute.

Extension of Missouri Navigation Recommended

COMPLETION OF A Corps of Engineers report recommending extension of the authorized 9-ft navigation channel project from Sioux City, Iowa, to Yankton, S. Dak., is announced by Brig. Gen. S. D. Sturgis, Jr., Missouri River division engineer. Based on long-time data collected by the Division and District offices of the Corps, the report also states that "improvement of the Missouri River for navigation up to Williston, N. Dak., is entirely feasible from an engineering standpoint, and should be prosecuted in a step-by-step manner, proceeding upstream as the needs of an expanding regional economy demand."

Approval of the Rivers and Harbors Board and the Office of the Chief of Engineers is necessary before the recommendation can be submitted for Congressional action.

Chicago Improvements to Expedite Traffic in Loop District

TWO MAJOR CONSTRUCTION projects currently under way in downtown Chicago will ultimately aid in relieving the congested traffic situation in the business district. These are a new Greyhound bus terminal which has been designed to keep all bus traffic off the streets in the Loop area, and a two-level extension of the present Wacker Drive south from Lake Street to Van Buren Street, where it will make a juncture with the Congress Street Superhighway.

Greyhound Bus Terminal

Work on an $8,000,000 Greyhound bus terminal started in May 1949 on a 66,000-sq ft site, comprising the west half of the block bounded by Randolph, Clark, Lake, and Dearborn streets near the center of the Loop. The terminal proper will be a four-level structure, with two floors devoted to waiting rooms and bus-loading platforms below the street level. The terminal entrance, as well as a number of stores and restaurants, will be located at street level, and the second floor and roof area will be devoted to car parking facilities. Over 500 ft of street frontage will be available for stores in the terminal. The bus-loading concourse, 25 ft below street level, will have sawtooth spaces for 31 buses and an elaborate ventilation system to ensure fresh air despite engine exhaust.

To keep the buses off the street level, they will enter and leave the sub-surface loading concourse through a private tunnel, 80 ft long, under Lake Street, the north boundary of the site. With an entrance on the north side of Lake Street, the tunnel will connect with Garvey Court, from where buses will run north to the lower level of the present Wacker Drive, a two-level thoroughfare along the Chicago River.

The terminal itself has a unique type of foundation in that its subterranean portions are anchored like a boat. This type of construction is employed because of the unusually wide column spacing (60 ft) required for roadways and platforms on the bus-loading level. For maximum strength and rigidity, the basement floor slab is 18 in. thick, reinforced with ribs anchored to steel-reinforced, bell-bottom piles driven 60 ft into subsoil hardpan.

The foundations are adequate to support a projected twelve-story tower office building. Completion of the tower section, which will cost an additional $5,000,000, will depend upon the demand for office space and future building conditions. The terminal building is scheduled for completion in the fall of 1951.

Skidmore, Owings & Merrill, of Chicago, are the architects and engineers, and Erle F. Webster is supervising architect for the Greyhound Corp.

Wacker Drive Extension

The Wacker Drive Extension, which is being built by the City of Chicago at an approximate cost of $12,500,000, will carry the present two-level Wacker Drive south from Lake Street to Van Buren Street, where it will intersect the Congress Street Superhighway. Occupying the present Market Street widened to about 134 ft, the eight-block (0.7-mile) double-deck highway is planned for completion in 1955.

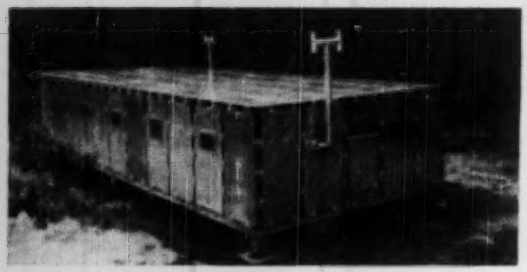
Work on the first block, between Lake and Randolph streets, began in June 1949, with the upper deck finished and opened to traffic this June. Construction is under way on the second block, Randolph to Washington streets, while the third block, from Washington to Madison streets, is in the contract-plan stage. Builder of the initial two blocks is the Herlihy Mid-Continent Construction Co.

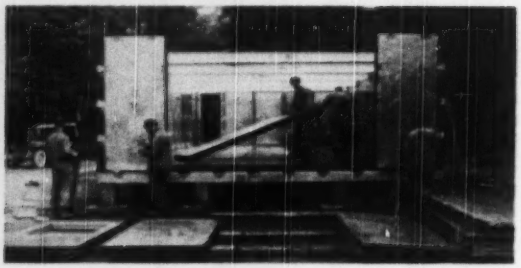
The upper level of the extension will consist of three lanes each, for north- and south-bound traffic, separated by a median strip. Of reinforced concrete flat-slab design, the structure is supported by octagonal columns, 3 ft wide and 14 ft high, resting on caissons 4 ft in diameter, sunk to a depth of about 75 ft to very hard clay. The lower level will provide two lanes in each direction for through traffic and one service lane adjacent to private property on each side of the through lanes. Ramps located in the median strip will provide access from one level to the other.

Construction costs are shared equally by the city, state, and county, with federal-aid highway funds used for the state's participation. The Department of Subways and Superhighways, headed by V. E. Gunlock, M. ASCE, commissioner, is in charge of the work for the city.

TRAFFIC DISTRIBUTOR AT INTERSECTION OF WACKER DRIVE EXTENSION and Congress Street Superhighway is shown in artist's sketch in left-hand view. Site of new Greyhound Terminal, photographed in May 1950 when all buildings had been cleared from 66,000-sq ft area and caisson work and construction of west wall were under way, is shown at right. Extensive use of plate glass and stainless steel will give terminal exterior highly modern architectural design.

New Army Building Is Designed for Use in Arctic Climates





FOR SHELTERING TROOPS IN SEVERE WINTER CLIMATES, Engineer Research and Development Laboratories at Fort Belvoir, Va., have completed prefabricated building, designed to withstand Arctic winds of 100 mph and temperatures of −65 deg F. Developed under contract with Chrysler Corp., building is of stressed skin aluminum construction, with side, roof, and floor panels of honeycomb core faced on both sides with aluminum alloy. Unit now undergoing tests is 48 ft long, 20 ft wide, and 8 ft high, and variations in length are possible in 8-ft increments from basic 8-ft length. Simple, wedge-type connector pin holds panels together, permitting erection by untrained troops. To be used primarily for troop occupancy, unit contains its own heating and sanitation facilities. Building is shown here in finished form (left) and with sides and one end complete and ceiling joists in place (right).

NSPE Issues Statement on Collective Bargaining

THE NATIONAL SOCIETY of Professional Engineers explains its stand on collective bargaining in a recently issued "Statement of Principles Regarding Collective Bargaining by Professional Employees." The statements, which were adopted in Boston by the organization's Board of Directors in June 1950, read as follows:

"1. It is definitely unprofessional for a professional engineer, professionally employed, voluntarily to join a heterogeneous labor union, dominated by, or obligated to, nonprofessional groups. As stated by the society, through its Board of Directors at Oklahoma City in September 1948, 'The individual responsibility and independent judgment required of a professional engineer are incompatible with the regimentation fundamentally inherent in unionization.'

"2. Organizations of professional engineers for collective bargaining, in any form are to be deplored, although their existence, for the present, may be condoned under certain circumstances."

In an explanatory footnote to the first statement, the NSPE Board states that nothing in it should be "construed as a criticism of engineers who may be forced to join a labor union against their will," but recommends that engineers in such a situation "seek to extricate themselves by due process of law." Similarly the footnote points out that nothing in the statement should "be construed as a criticism of engineers-in-training, who voluntarily join a labor union when . . . they are temporarily employed in nonprofessional or subprofessional work, where their fellow workers are organized. When promoted to professional responsibilities, however, the engineer cannot continue his labor union affiliations without sacrifice of professional status."

Footnotes to the second statement remark that "When engineers are treated collectively by an employer they may be compelled to deal with him on the same basis." Urging greater employer appreciation of individual capacities and talents and consideration of them on an individual basis, the footnote continues, "When employers generally are persuaded that professional employees must be viewed as individuals and *not* in groups or classes, then NSPE may condemn collective bargaining by professional engineers, without qualification. In the meantime, we advise the young engineer that the existence of collective bargaining by professional engineers in an industry jeopardizes his professional status. Either the employer fails to appreciate the professional nature of his engineers' work, or the employees themselves are not adhering to professional concepts. Therefore professional engineers and engineers-in-training should not seek employment where professional engineers, professionally employed, bargain collectively."

ASCE Activities in Professional Employment Reviewed

To refresh memories, ASCE interest in collective bargaining began in 1937 shortly after the passage of the Wagner Act, which the Board of Direction recognized as a possible threat to the welfare of professional engineers. A nationwide investigation was made in 1942 of the extent of unionization among engineers and the circumstances prompting engineers to join unions. Soon after, the Society's Committee on Employment Conditions prepared and published as a Society Manual information on the Wagner Act and its administration as they affected engineers.

Early in its study ASCE took the view that its members should have full freedom to join or not to join a union; that there should be no legal pressure requiring an engineer to join any union in order to practice his profession; and that collective bargaining by employees can be conducted on a dignified professional level.

The ASCE Board in October 1946 formally adopted the following statement of principles and policy which closely followed those of its 1937 Committee.

"1. Any group of professional employees who have a community of interest and who wish to bargain collectively should be guaranteed the right to form and administer their own bargaining unit and be permitted free choice of their representatives to negotiate with their employer.

"2. No professional employee, or group of employees, desiring to undertake collective bargaining with an employer, should be forced to affiliate with or accept membership in any bargaining unit which includes nonprofessional employees, or to submit to representation of such group or its designated agents.

"3. No professional employee should be forced against his desire, to join any bargaining unit or other organization as a condition to his employment or to sacrifice his right to individual, personal relations with his employer in the matter of employment conditions."

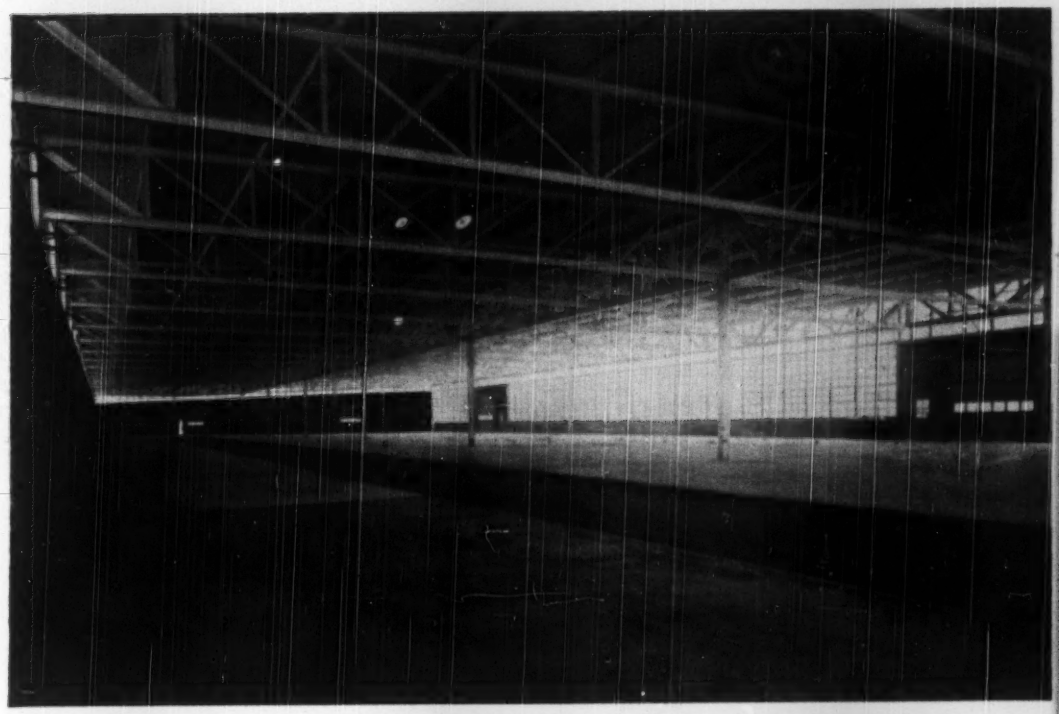
In December 1946 Engineers Joint Council adopted the ASCE statement as a basis of the "Professional Employee" provisions now included in the Taft-Hartley Act.

HHFA Loan Speeds Plans for Huge Sewerage System

AN INTEREST-FREE LOAN of $500,000 to assist the Allegheny County (Pennsylvania) Sanitary Authority in the preparation of plans for a $59,000,000 intercepting sewer system and a large treatment plant has been authorized by the Housing and Home Finance Agency. The loan constitutes the largest advance approved for a single project since reinstitution of the Advance Planning Program for non-federal public works.

The Allegheny County project consists of approximately 54 miles of intercepting sewer and force mains, much of which will be laid on the stream beds, and the big treatment plant on the Ohio, a few miles below the junction of the Allegheny and Monongahela rivers. Construction work will be started in 1952, with Metcalf & Eddy of Boston, as consulting engineers.

Arc-welded framing provides better building values



This modern shipping department of New Idea Division of Aviso Manufacturing Corporation, Coldwater, Ohio, well-known producers of farm machinery, is 120 ft. wide by 450 ft. long. Aisles are 60 ft. wide, employing Austin's H-section all-welded trusses. Bay spacing is also 60 ft. with two intermediate columns eliminated. This design provides an unusual degree of flexibility for plant layout.

By GEORGE A. BRYANT, *President*
The Austin Company
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N.Y. Water Board Opposes Use of Hudson River Water

OPPOSITION TO THE use of Hudson River water as a permanent source of supply for New York City is expressed by the New York Board of Water Supply in a letter to Mayor O'Dwyer prepared in answer to a plan suggested by Lawrence T. Beck, M. ASCE, engineer for the Citizens Budget Commission. The Beck plan, which proposes that the city derive its permanent additional water supply from the lower Hudson, calls for construction of a barrage-type dam across the Hudson between Haverstraw and Chelsea, N.Y. (March CIVIL ENGINEERING, page 62).

Apart from what it calls "the tremendous engineering difficulties" involved in the proposal and the fact that approval of the Army Corps of Engineers "is extremely doubtful," the Board of Water Supply rejects the plan "as entirely impractical to meet and solve the city's additional permanent water supply problems." Major reasons advanced by the Board are the inferior quality of a Hudson River supply; damage to railroads, utilities, industry, and other owners of riparian rights that would result from the proposal to raise the elevation of the river a minimum of 3 ft above high water; the hindrance to navigation, especially during the season when ice packs in the river might jam the locks in the dam; and the vigorously expressed opposition of affected municipalities.

In addition, the Board states, the cost of the Beck plan would be nearer $629,000,000 than the $200,000,000 estimated. The Board estimates the probable cost of its 360-mgd Cannonsville Project on the Delaware watershed at $140,000,000. Annual operation of the Beck plan would be almost ten times as much per million gallons as the operating cost of the Cannonsville Project.

"However, regardless of cost," the Board summarizes, "the paramount factor influencing our conclusion is that the quality of the water which the Beck plan would supply to the people of New York from the Hudson River is definitely inferior and its use is prospectively hazardous."

The Board of Water Supply report is signed by Irving V. A. Huie, M. ASCE, president. Roger W. Armstrong, M. ASCE, is chairman of the consultants who prepared the report on which the Board bases its recommendations.

The Board of Water Supply experts named to study the city's water problems (CIVIL ENGINEERING, June, page 66) has not reported.

Effect of Truck Loads on Pavements Is Studied

THE EFFECTS OF concentrated truck traffic of various axle loads on one type of concrete pavement are being studied by the Highway Research Board in a research project south of Washington, D.C., designated Road Test One—MD. Two pairs of single-axle trucks, loaded to 18,000 and 22,400 lb, and two pairs of tandem-axle trucks, loaded to 32,000 and 44,800 lb, have started 24-hour operation. The schedule calls for an average frequency of more than a truck a minute on each of the four sections of the test stretch, with each pair operating on a separate section so that relative effects of different load and axle arrangements can be observed.

In addition to detailed records of cracks or other trouble that may develop in the pavement, observations will be made of stresses and strains in the slabs to permit exhaustive studies of the character and condition of the concrete and underlying soils.

Administered and conducted by the Highway Research Board in cooperation with the Bureau of Public Roads, the project is being supervised by A. Taragin, who has been assigned to the Board for the job by the Bureau of Public Roads. Contributions for financing are supplied by a number of states, and truck manufacturers are lending trucks.

Federal Directive Asks Examination of Public Works Program

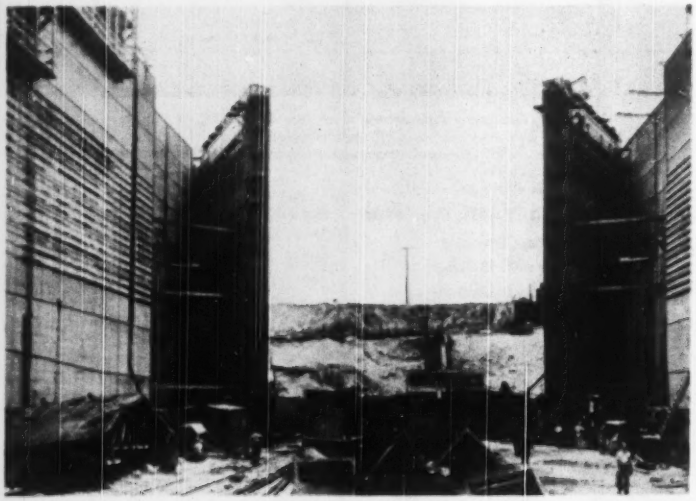
TO MEET THE threat of the Korean situation, President Truman has issued an order requesting reexamination of all civil works programs, both direct and grants-in-aid, "with the object of giving first priority to those which contribute directly to national defense . . . or to civilian requirements essential to the changed international situation." It is recommended that other projects be "deferred, curtailed, or slowed down."

The possible effect of the directive in the field of road building is emphasized in a recent release from Secretary of Commerce Charles Sawyer. Stating that the Bureau of Public Roads is enlisting the cooperation of state highway departments in making the desired reexamination of federal-aid highway programs, the release points out that the order does not affect work under contract.

"The immediate objective of the study," it states, "is to identify projects in the program which contribute directly to defense . . . . Highway improvement projects on the National System of Interstate Highways and important projects on the federal-aid primary, urban, and secondary systems are recognized as contributing directly to the national defense and therefore are worthy of high priority consideration. Also of recognized essentiality are all highway maintenance activities."

In addition to the road program, the directive will affect construction of rivers and harbors, dams, and hospitals, and irrigation, reclamation and soil-conservation projects.

Giant Lock Will Aid Mississippi River Navigation



HUGE DETOUR LOCK, designed to eliminate hazards to seasonal navigation through Chain of Rocks Channel of Mississippi River near St. Louis (June 1949 issue, page 44), nears completion. These 80-ft-high gates at downstream end of main lock of Locks No. 27 were fabricated and erected by American Bridge Co., U.S. Steel Corp. subsidiary. Main lock is largest in entire Mississippi River system and among longest in world. Army Corps of Engineers is in charge of the $18,000,000 project, which will eliminate last serious barrier to full utilization of navigable channel extending from New Orleans to Minneapolis. Both main and auxiliary locks are scheduled for completion by September 30. U.S. Steel Corp. photo.

TONAWANDA, N.Y.

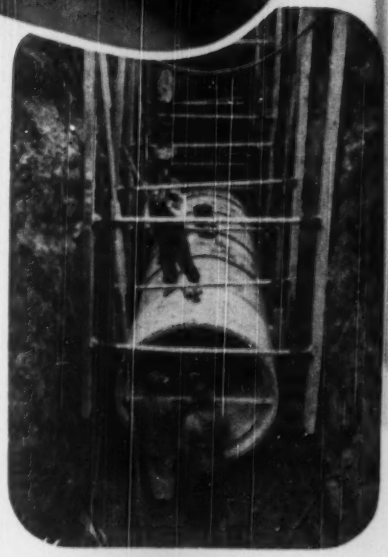
concrete sewer system features many types of construction

LEGEND says Tonawanda, N.Y. means "swift water." The growth of this industrial city has been so rapid, however, that east side residents frequently found their sewers did not flow swiftly enough. Because of inadequate storm sewers, storm waters emptied into sanitary sewers, which backed up with every heavy rain, flooding basements and endangering health.

To solve this problem a new concrete storm sewer system, unusual in many respects, was built. It includes more than 3½ miles of reinforced concrete box sewer 16 ft. x 7 ft., 10 ft. x 7 ft., 7 ft. x 6 ft. and a dual 9-ft. x 7-ft. section. The system also required more than two miles of reinforced concrete sewer pipe ranging in size from 18 in. to 78 in.

The Tonawanda Town Board officials believe that the funds expended for this project will be repaid in taxes many times because of increased valuation from developments in the area. Already industrial, apartment and retail store building have boomed and more than 1,500 homes have been completed.

Concrete sewer structures such as these render lifetime service. First cost is moderate and maintenance requirements are quite low. The result is ***low-annual-cost*** sewer service.



Upper photo shows completed reinforced concrete box sewer, 7 ft. high x 16 ft. wide, before backfilling, on section A of project. McLain Construction Co., contractor. Lower photo shows installation of 66-in. reinforced concrete sewer pipe in a 24-ft. cut on section D of project. Herbert F. Darling, contractor. Nussbaumer & Clarke, consulting engineers on entire project.

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Demand Exceeds Supply of Engineering Graduates

Thorndike Saville, M. ASCE
Dean of Engineering, New York University

WIDESPREAD PUBLICITY IN both the daily and professional press was accorded a news release on "Employment Outlook for Engineers" issued in March by the Bureau of Labor Statistics. This release called attention to the large numbers of engineering students graduating in June 1950 as compared with prewar numbers, and presented a pessimistic outlook as to the immediate availability of sufficient engineering jobs to absorb them. Worst of all was a colored pictorial chart accompanying the release which showed the rapid increase in engineering graduates since 1945. This chart, which carried the caption "so many will be graduated in the next few years that many graduates will be unable to get jobs," came into the hands of hundreds of high school advisers, and the implications were reported in nationally distributed popular magazines. In the opinion of a great many engineering college administrators, the impressions thus conveyed are in no small measure responsible for the sharp decline in freshman enrolment in engineering colleges for September 1950, which may well be below prewar figures.

The Bureau of Labor Statistics presented a generally "bullish" appraisal of future opportunities in engineering in its full release and report, but this was apparently overlooked in favor of the more spectacular short-term forecast. The Bureau stated "Engineering is the nation's third largest profession and one of the fastest growing — great numbers of engineering jobs will be available over the next decade. . . ."

More recent detailed studies by the Manpower Survey Committee of Engineers Joint Council and by the Manpower Committee of the American Society for Engineering Education have produced data indicating that, even without the developing war situation, engineering graduates will be in short supply by June 1952 if not before. M. M. Boring, of the General Electric Company and chairman of the first named committee, stated in June 1950 that "four out of five engineers graduated this June in the largest class in the history of engineering education in America have accepted jobs or received job offers. . . . There is much evidence that, if we have a small enrolment in the freshman classes entering this fall, we will very clearly face a serious shortage of engineering graduates four years from now."

Reporting in *Higher Education* for April 1950, an official organ of the United States Office of Education, H. H. Armsby, the agency's specialist in engineering education, stated that "a recent survey by the Engineers Joint Council of actual placement results indicates about 35,000 graduates of last year's class (June 1949) have been placed in jobs which utilize their engineering training, a figure almost twice as large as the estimate of the Bureau of Labor Statistics."

More recently, in a report for the Manpower Committee of the American Society for Engineering Education in June 1950, Mr. Armsby presented an elaborate statistical analysis of engineering enrolment. He showed that in the prewar days of 1938 and 1939 there were approximately 32,000 freshmen and about 13,000 graduates. The rush of veterans to engineering colleges after the war increased enrolments almost fantastically. The maximum number of freshmen (91,000) was enrolled in 1945–1946, and the graduation of the survivors produced the maximum number of graduates (51,000) in June 1950. Nonetheless, no serious unemployment problem arose.

Though the future looks rosy for the engineering graduate, it may be dark for the national efforts dependent upon engineers. The number of freshmen declined to 42,000 in September 1949, and is estimated at no more than 36,000 in September 1950. The latter enrolment would produce about 20,000 graduates in June 1953. If 35,000 engineering graduates obtained real engineering jobs in 1949, and probably more from the large 1950 class are similarly employed, it seems clear that a serious shortage of young engineers is impending.

The "cold" and "hot" wars, attended by partial military mobilization and marked expansion in war industries, have rapidly absorbed any real surplus of June 1950 engineering graduates. The freshman engineering classes are approaching prewar proportions, and are already smaller than would have been the case if the prewar gradient of increase in engineering college freshmen had been maintained. The scarcity of young engineers in the last war was notable, and means for their effective utilization were little short of shameful.

Two major obligations appear to be the responsibility of engineering college administrators and the engineering profession with respect to engineering education in the growing national emergency. The first is to make every effort to convince high school students and their advisers that even apart from emergency conditions there are certain to be ample job opportunities for engineering graduates four years hence, excepting always a national economic depression. The second is to convince those in charge of government's manpower allocations that engineers vitally necessary to any extended military effort must first be trained and subsequently allocated to military or industrial services where that training can be most effectively utilized. In these days of increasing applications of applied science to military and related industrial activities, there be no substantial "short cuts" to engineering education, and a proportion of first-degree graduates must be permitted to go on for graduate work to prepare for highly specialized assignments in the armed services and in industry.

Let us not forget that adequate and qualified faculties must be maintained in our engineering schools, not only for instructional purposes, but to conduct research vitally important to national defense. I make no plea for universal deferment of engineering college students or faculty, but for an appraisal of national needs in engineering manpower, and for clear and authoritative directives as to how those needs should be met. The colleges of engineering contributed mightily to training and research in World War II. They are ready for even greater responsibilities if called upon in the dangerous days ahead.

[This material is excerpted from Dean Saville's Annual Report, dated August 28, to the Chancellor of the University.]

New Mexico Ground-Water Levels Show Improvement

A SURVEY OF ground-water conditions in New Mexico, made by hydrologists of the U.S. Geological Survey and the State Engineer, shows some improvement in 1949, according to a Department of the Interior release. Declines in water level in some heavily developed or overdeveloped areas were less than predicted from the trend of the past few years, and in other areas there were actual rises in water level during the year. The improvement is attributed to above-normal rainfall during the 1949 growing season and consequent reduction in pumping for irrigation.

USBR to Ask for Bids on Hoover Power Plant Work

BIDS WILL SOON be invited on a major contract involving the first installations of equipment for generating units A-3, A-4, and A-9 in the Arizona wing of the Hoover Power Plant, according to an announcement from E. A. Moritz, director of Region 3 of the Bureau of Reclamation, Boulder City, Nev.

The contract will call for the installation of two 115,000-hp and one 70,000-hp hydraulic turbines with pressure regulators and governors for two 82,500-kva and one 60,000-kva generating units. Other work items include assembly and installation of two 168-in. and one 120-in. butterfly valves; construction of two switchyards; installation of seven 30,000-kva and four 21,000-kva power transformers; erection of generator-voltage bus structures; and construction of additional transmission lines from the powerhouse to the switchyard.

Units A-4 and A-9 are scheduled to go on the line in November 1951, and A-3 to follow in January 1952. The three units will complete installation of the Arizona wing of the Hoover Power Plant, raising its capacity to 1,249,800 kw.

New Jersey Awards Large Turnpike Job

AWARD OF A major New Jersey Turnpike contract to the Poirier & McLane Corp., of New York, is announced by Paul L. Troast, chairman of the New Jersey Turnpike Authority. The amount of the contract, which provides for construction of 19 bridge superstructures in Union County and of a viaduct between relocated Bayway Avenue and Humboldt Avenue in Elizabeth, is $4,068,675.

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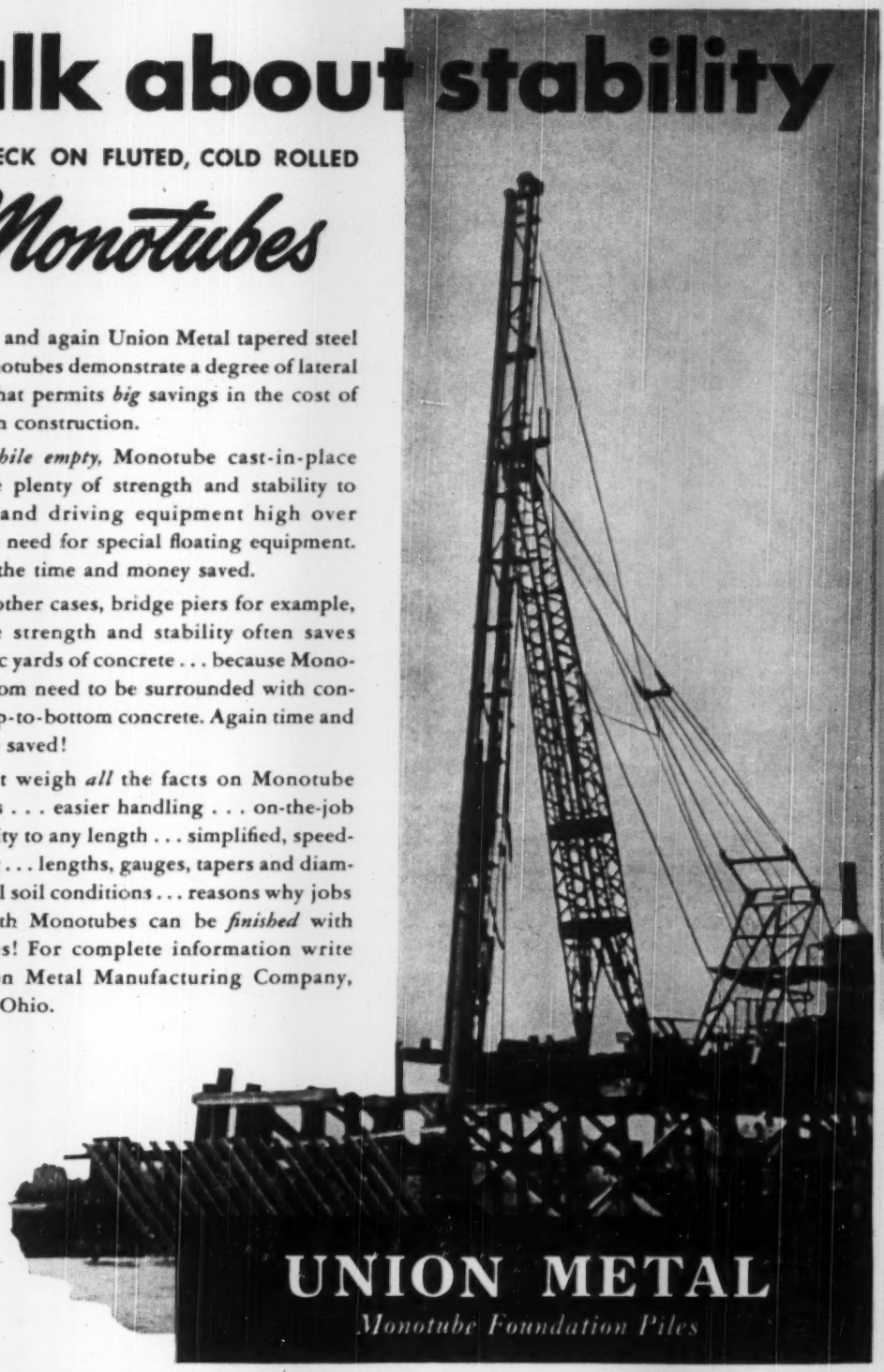

UNION METAL

Monotube Foundation Piles

Construction Proceeds on Tacoma Narrows Bridge

SPECTACULAR MILE-LONG Tacoma Narrows Bridge, now nearing completion (July issue, p. 99), rises on enlarged piers of former bridge that collapsed in 1940. Subjected to winds up to 100 mph in model tests, present structure is being built by Washington Toll Bridge Authority, with C. E. Andrew, M. ASCE, chief consultant. Steelwork is by Bethlehem Steel Co. and concrete work by Woodworth & Co., Tacoma. Present view shows plywood forms in place on Tacoma-side anchor, and toll house.

NEW IN Education

AN INSTITUTE ON Coastal Engineering, sponsored by the department of engineering and the division of engineering extension of the University of California, in cooperation with the department of institutes and lectures, will be held in the Municipal Auditorium at Long Beach, October 11–14. The Institute will summarize current information and techniques for engineers engaged in the design, construction, operation, and maintenance of coastal works. For further information write to the Department of Institutes and Lectures, University Extension, University of California, Los Angeles 24, Calif.

NEW DEVELOPMENTS IN ground facilities for landing and dispatching aircraft and for handling air passengers and cargo will be the subject of a Conference on Ground Facilities for Air Transportation, to be held as a part of the 1950 summer session at Massachusetts Institute of Technology, September 12–14. Sponsoring the conference, in cooperation with MIT, are the Port of New York Authority, the Civil Aeronautics Administration, and the Massachusetts Aeronautics Commission. The committee in charge of arrangements includes Prof. John B. Wilbur, M. ASCE, head, department of civil and sanitary engineering, and Prof. A. J. Bone, Assoc. M. ASCE, department of civil engineering. Inquiries should be addressed to Professor Bone, Room 1-349, Massachusetts Institute of Technology, Cambridge 39, Mass.

RESUMPTION OF THE City College graduate program in engineering after a ten-year lapse is announced today by Dean William Allan, M. ASCE, of the college's school of technology. The new graduate program leading to a master's degree in mechanical, chemical, civil, and electrical engineering will be based on a two-year curriculum study recently completed by the school, Dean Allan disclosed. Classes will begin during the week of September 25. A descriptive folder may be obtained from the Graduate Office, City College School of Technology, New York City 31.

SUCCESSFUL OUTCOME OF the Third Annual Pennsylvania Sewage and Water Works School, held recently at the Pennsylvania State College, is reported by Robert E. Stiemke, Assoc. M. ASCE, professor of sanitary engineering. There were 42 registrants at the sewage works school and 92 at the water works school. The program was conducted by the school of engineering at Penn State, with sponsorship of the Pennsylvania Department of Health, the Pennsylvania Sewage and Industrial Wastes Association, and the Institute of Local Government at the college. Cooperating agencies were the Pennsylvania State Association of Boroughs, the Pennsylvania Municipal Authorities Association, and the League of Cities of the Third Class in Pennsylvania.

SUBURBAN SANITARY SERVICES will be the theme of the Third National Public Health Engineering Conference, to be held at the University of Florida, Gainesville, October 23–24. Speakers will include ASCE members Wylie W. Gillespie, Jacksonville consultant; C. D. Williams, head professor of civil engineering; Gordon M. Fair, dean, Graduate School of Engineering, Harvard University; David B. Lee, chief sanitary engineer, Florida State Board of Health; George W. Simons, Jr., city planner of Jacksonville; John E. Kiker, Jr., professor of public health engineering; and Mark D. Hollis, assistant surgeon general, U.S. Public Health Service, Washington, D.C. For more detailed information write to Professor Kiker, College of Engineering, University of Florida, Gainesville, Fla.

ONE OF THE first detailed studies ever made in this country of the growth patterns of metropolitan areas will be undertaken by the Scripps Foundation, Miami University, Oxford, Ohio, under the sponsorship of the Housing and Home Finance Agency, according to Raymond M. Foley, HHFA Administrator. The Scripps Foundation studies, to be based on census and other data, will include every metropolitan area. The results are expected to be of practical value to all segments of the house-building industry, to government housing agencies, and to the public generally. Under the terms of an agreement with the new Division of Housing Research of the HHFA, the Foundation will develop (1) an explanation of the patterns of growth and of economic change in metropolitan areas and (2) conclusions concerning the nature of the change of population composition and of the change in economic functioning that accompanies metropolitan growth.

Opportunities for Study Abroad Listed by UNESCO

AVAILABILITY OF A total of 21,751 opportunities for foreign study and research is noted in the new edition of UNESCO's international handbook, *Study Abroad*. The volume, second in a series published annually by UNESCO, lists one-third more grants than the predecessor volume. The list of fellowships, scholarships, and grants-in-aid, classified according to the country of origin, credits the United States with 5,096 awards made through private institutions and universities and government sources. Nearly half the awards catalogued are in unspecified fields, allowing candidates a wide choice of study. "Engineering and technology," with 4,421 opportunities listed, leads the special categories.

Distribution of the handbook has been made to a number of colleges and universities. Additional copies are on sale from the Columbia University Press, 2960 Broadway, New York, at $1.25 each.

U.S.G.S. to Continue N.Y. State Ground-Water Survey

COOPERATIVE AGREEMENTS TO continue ground-water investigations in New York State through March 31, 1951, have been signed by the U.S. Geological Survey and the Water Power and Control Commission of the New York State Conservation Department. To be financed on a 50-50 basis, the studies will include Long Island, which draws heavily on its ground-water resources for drinking water, irrigation, and industrial processing. Upstate the collection of basic data will aid in the development of drinking water supplies for a population of almost 3,000,000 and new sources of supply for farms, transportation, and industry.

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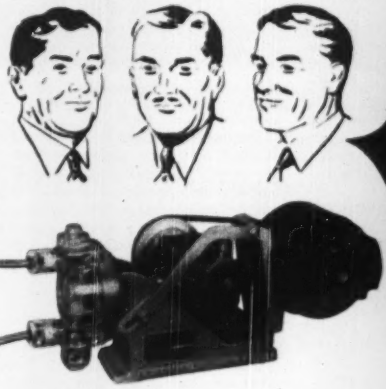

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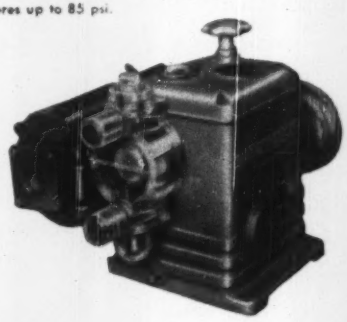

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R. Robinson Rowe, M. ASCE

PROFESSOR NEARE was missing! Joe Kerr noticed it first and brightened up at the thot that for once he wouldn't have to play the dunce. "Too bad, tho," he said out loud, "because the problem was easy and I had the right answer."

"We'll call that bluff right away," challenged Stoop Nagle. "Did you forget who proposed it?"

"Gosh, that's right; you were Guest Professor. Well then, if Rodney slips on one problem in four, he would most probably miss 60 out of the 240. But since the checker detected 56 mistakes and only slips once in 5 times on the average, there should have been 70 mistakes for him to find. This brackets the answer between 60 and 70, within which 65 is the most likely. Easy, just like I said!"

"Too easy to be right," commented Cal Klater caustically. The matter has to be treated binomially. If Rodney made x mistakes, the probability of the event can be expressed ${}_{240}C_x \left(\frac{1}{4}\right)^x \left(\frac{3}{4}\right)^{240-x}$ where ${}_{240}C_x$ is the coefficient of a^x in the expansion of $(a + 1)^{240}$. Similarly, the probability of Chaney detecting exactly 56 of the x mistakes is ${}_xC_{56} \left(\frac{4}{5}\right)^{56} \left(\frac{1}{5}\right)^{x-56}$, so that the probability of concurrence of the two events is:

$$P_x = {}_{240}C_x \cdot {}_xC_{56} \left(\frac{1}{4}\right)^x \left(\frac{3}{4}\right)^{240-x} \left(\frac{4}{5}\right)^{56} \left(\frac{1}{5}\right)^{x-56}$$

$$= \frac{3^{240-x} \cdot 240!}{4^{184} \cdot 5^x \cdot 56! \, (240 - x)! \, (x - 56)!}$$

"That looks very imposing, but supposing you set up an analogous expression for $x - 1$ mistakes and divide one by the other. The result is:

$$\frac{P_x}{P_{x-1}} = \frac{241 - x}{15(x - 56)}$$

As x increases, the probability increases as long as this fraction exceeds unity. Setting it equal to unity, we reduce it to $16x = 1081$, and hence $x = 67$."

"Exactly right, Cal. In fact there's little I can add, except to put the solution in general terms. If the chances of success and failure, respectively, of Rodney and Chaney, respectively, are represented by the usual p_1, p_2, q_1, and q_2, and if Chaney finds a mistakes in N problems, then x is implied in $p_1(x - a) = q_1 q_2 (N + 1 - x)$.

"Incidentally, when Noah learned he couldn't be here, he asked me to introduce Guest Professor Jenney. He just bought some poultry he wants to tell you about."

"Exactly $100 worth," said Professor Jenney. "How many roosters did I get if I paid $2.41 a pair and got 79 birds?"

[Cal Klater was Sauer-Doe (Marvin A.) Larson and the Guest Professors were John L. Nagle and Richard Jenney.]

Prestressing Is Applied to Structural Steel

SUCCESSFUL APPLICATIONS OF prestressing to concrete structures (CIVIL ENGINEERING, July 1950, page 28) have stimulated Prof. Gustave Magnel, M. ASCE, to investigate whether similar principles could not be applied to structural steel. "Since steel has the same resistance in tension as in compression, there is no need to precompress it in order to induce an artificial resistance in tension," he states in a recent article entitled, "Precompressed Structural Steel Construction," which appeared in the June issue of *L'Ossature Metallique*, Brussels. "Even though the reasons for precompressing steel tension members are not the same as those for precompressing concrete, the application of a technique of "prestressing" steel can result in appreciable savings, both in weight and cost," he writes.

The article contains a rather detailed theoretical analysis of the design of precompressed steel trusses and economies to be expected. Savings in weight up to 33 percent are available, and assuming the cost of materials and labor for high yield strength wire units to be three times that of structural steel, a 13 percent saving in cost is obtainable.

The 47-ft truss, illustrated here, was designed in accordance with theoretical methods developed by Professor Magnel. Its bottom chord was precompressed with one Magnel-Blaton wire unit, consisting of 16 wires, 0.2 in. in diameter, similar to those used in the Walnut Lane Bridge, Philadelphia (yield strength 218,000 psi).

During the precompressing operation this tension member was restrained from buckling by the wires, by means of which the precompression was applied. A large number of SR4 strain gage measurements were made during the precompression and during the application of loads. Final failure of the truss was by buckling of its unbraced top chord.

By comparing his design computations with the test measurements, Professor Magnel concludes that stresses in a precompressed steel structure can be computed with the same accuracy as for conventional steel design, and believes that precompressed steel trusses 15 ft deep could economically span 500 ft.

He urges steel-minded engineers in the United States to explore further the development of precompressed steel girders already under way and to investigate the place of precompressed steel in our economy.

Material for this release was submitted by Charles C. Zollman, Assoc. M. ASCE, staff engineer, The Preload Corp., New York, N.Y.

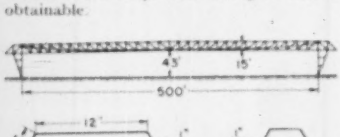
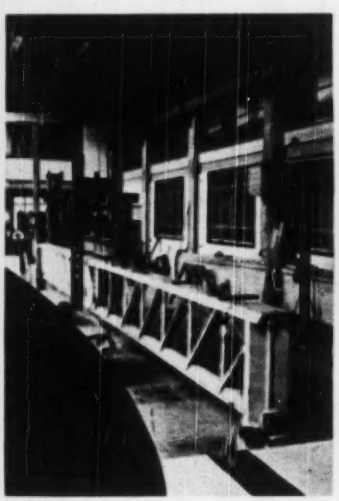
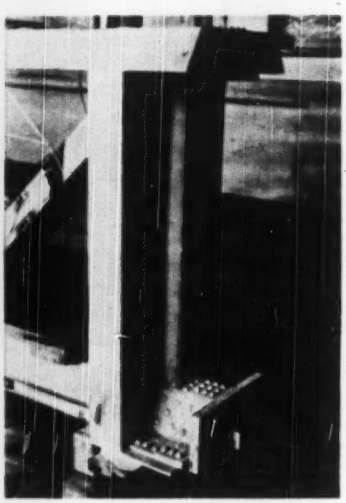


FIG. 1 (upper left) shows proposed precompressed truss for hangar. Fig. 2 (lower left) shows sections of test truss pictured below.





STRUCTURAL STEEL TRUSS, 47 ft long (left-hand photo), with precompressed bottom chord is tested to failure in Belgian Laboratory. In view at right, precompression stress is applied to bottom chord by means of eight pairs of high-yield strength wires.

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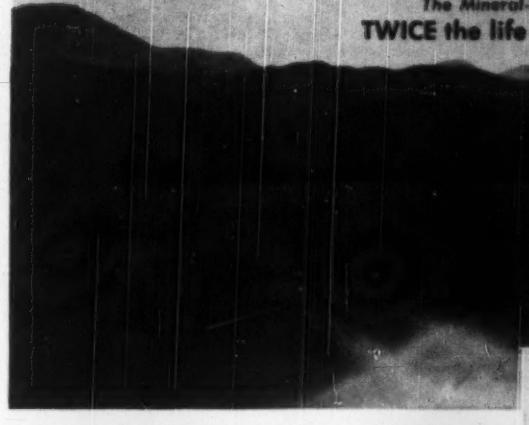

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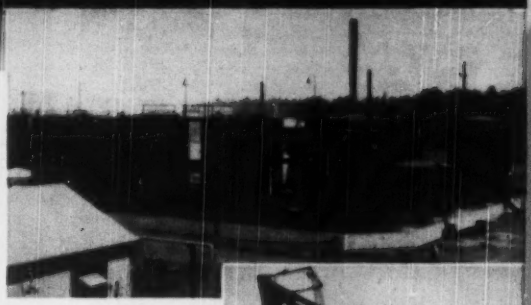

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Deceased

Otto Kopp Jelinek (M. '40) consulting engineer and traffic expert of Chicago, died suddenly on August 17 in Brussels, Belgium, where he was on vacation. Mr. Jelinek's work as park district traffic engineer from 1934 until his resignation in 1946 to enter consulting practice brought him many honors, including the Octave Chanute Medal of the Western Society of Engineers. He designed the Lake Shore Drive highway system and invented the movable dividers in use on the drive. In practice with Ralph H. Burke, M. ASCE, for the past four years, he had specialized in the design and construction of airports, and the firm was airport consultant for the city. At the time of his death Mr. Jelinek was president of the Illinois Section of ASCE and a member of the executive committee in charge of the Chicago Meeting (see photo, page 55). Mr. Jelinek was educated at Armour Institute of Technology.

Charles Metcalf Allen (M. '11) professor emeritus of hydraulic engineering at Worcester Polytechnic Institute, died at his home in nearby Holden, Mass., on August 15. His age was 78. He was on the WPI staff from his graduation there in 1895 to his retirement in 1945 - from 1909 on as professor of hydraulic engineering. After his retirement, Professor Allen remained as director of the college's Alden hydraulic laboratory, where he supervised many projects for the Army and Navy during the second World War. He originated the "salt-velocity" method of measuring flow, which has international acceptance. For his work on hydraulic problems he received the Society's James Laurie Prize in 1925 and the John Fritz Medal in 1949.

Charles Metcalf Allen

Allen Claude Boggs (M. '36) retired engineer of Berrien Center, Mich., died there on May 17. He was 65. At the time of his retirement five years ago, Mr. Boggs was construction engineer for the Standard Oil Co. in Indiana. He was engineer in charge of Pennsylvania Railroad Lines, West, at Pittsburgh, Pa., from 1910 to 1920. He received his engineering degree from Purdue University.

Frank Cranstoun Boggs (M. '09) died at his home in Paoli, Pa., on April 18, at the age of 76. He graduated from the U.S. Military Academy in 1890 and the School of Application in 1903. From 1890 to 1894 Mr. Boggs was in the employ of Wilson Brothers, engineers and architects. He then joined the Corps of Engineers, which he served in Tampa, Fla., the Philippines, Wheeling, W. Va., and as general purchasing officer, in charge of the Washington office, of inspection of materials for the Isthmian Canal Commission. He was also engaged by the Corps on the design and construction of locks and dams on the Ohio, Little Kanawha, and Kanawha rivers.

Herbert Kingsbury Dodge (M. '31) retired engineer of Camp Hill, Pa., died there recently, at the age of 78. After graduation from Iowa State College in 1903, Mr. Dodge became associated with the American Bridge Co. For a number of years he was employed by Allegheny County (Pennsylvania), where he had charge of the design of bridges in Pittsburgh, and other cities. He then joined the Pennsylvania State Highway Department as bridge engineer.

Frederick William Greve (M. '43) professor of civil engineering at Purdue University, West Lafayette, Ind., died there on June 13. He was 64. Professor Greve had been a member of the Purdue faculty since 1911. An authority in hydrology, he was author of numerous papers and articles in that and related fields. He received his schooling at the University of Wisconsin and Oregon State College, and was a member of ASME, ASEE, several honorary engineering fraternities, and a Mason.

Ralph Hansen (Assoc. M. '39) chief of the soils foundation and frost effects laboratory of the New England Division of the Army Corps of Engineers, died on July 25, at the age of 53. Mr. Hansen was educated at Lowell Institute and the Massachusetts Institute of Technology. He had been engaged in the building design field before joining the Engineer Corps in 1934. He was widely known for his studies on frost action on highway pavements and airfield runways and for his research in soil mechanics.

John Albert Johnston (M. '12) retired engineer of Worcester, Mass., died there on July 24 after a long illness. He was 78. A pioneer in the use of the clover-leaf design for highway intersections, Mr. Johnston served as resident engineer for the Worcester Division of the Massachusetts Highway Commission. Earlier he worked for the West End Street Railway in Boston and the City Surveyors' Department there. He graduated from the MIT.

Charles Rex McNiece (Assoc. M. '16) former engineer with H. Ralph Hadlow, consulting engineers of Cleveland, Ohio, died at Lakewood, Ohio, on April 18, at the age of 61. A 1911 graduate of the Case Institute of Technology, Mr. McNiece was an engineer for the Carl Taylor Cream Cone Co. for many years.

Edgar Donald Millstone (Jun. M. '47) engineer with the I. E. Millstone Construction Co., St. Louis, Mo., died on February 19. He was 25. From 1943 to 1946 he served in the U.S. Navy Seabees in the Pacific Theater of War. Mr. Millstone instructed in geometry at Yale University, where he had received his bachelor's and master's degrees in civil engineering.

Harry Johnson Morrison (M. '05) retired civil engineer of Gainesville, Fla., died there on July 19, at the age of 80. A civil engineering graduate of Harvard University, Mr. Morrison was engineer of federal roads in Florida for 23 years prior to his retirement in 1942. He was a Life Member of ASCE.

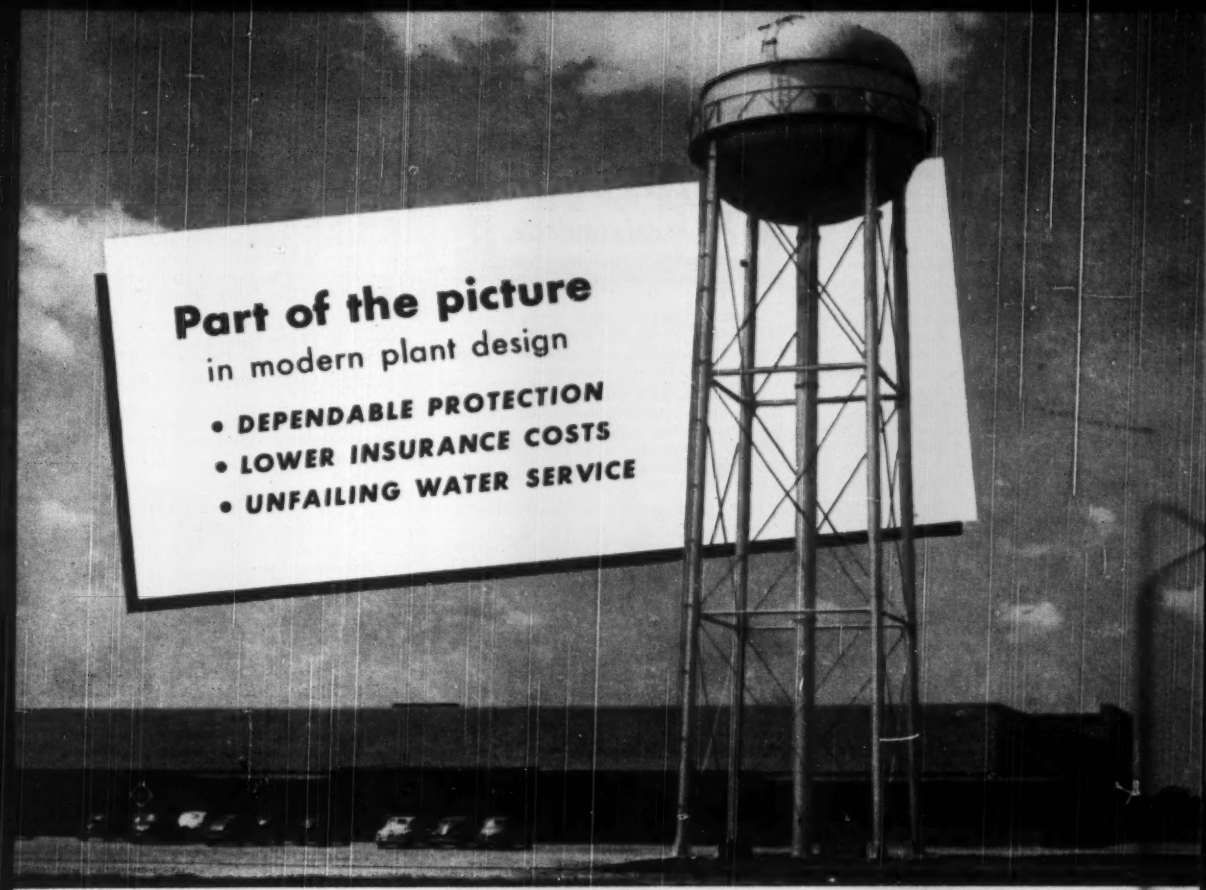
William Henry Mueser (M. '37) retired consulting engineer, died at Mount Kisco, N.Y., on August 4. He was 78. Mr. Mueser was born and educated in Germany, coming to the United States in 1893 as an engineering consultant. In 1900 he became a founder and partner in the firm of Concrete-Steel Engineering Co., New York City, which was dissolved in 1933. A pioneer in the development of steel reinforcement in concrete construction, he had designed many reinforced concrete bridges, including the Galveston (Tex.) causeway. He was a charter and honorary member of the American Society for Testing Materials.

Fred Dale Pyle (M. '20) since 1934 hydraulic engineer for the City of San Diego, Calif., died there on July 21, at the age of 67. A graduate of Utah State College, Mr. Pyle had been with the Bureau of Reclamation on the North Platte Project, the Kennewick Irrigation District in Washington, and the Imperial Irrigation District and Vista Irrigation District in California. He was employed by the City of San Diego as assistant hydraulic engineer in 1928, becoming hydraulic engineer in 1934.

Ray Stevens Quick (M. '29) retired construction engineer, died at his home in Pittsburgh, Pa., on May 26, at the age of 69. He had early engineering experience in Ohio, West Virginia, and Texas, and in the Pittsburgh Department of Public Works. For 33 years he was on bridge design and construction for the Bureau of Bridges, Department of Works, Allegheny County, retiring in 1948. Mr. Quick served at Fort Humphrey, Va., in the first World War and later in the Officer Reserve Corps as captain, 37th Engineers. During the recent war he was engaged as a captain in recruiting service at Pittsburgh. He was active in the formation of the San Antonio post of the Society of Military Engineers, a member of the American Legion, and a Mason. In 1950 he became a Life Member of ASCE.

Harry Lawrence Ramage (M. '36) consulting engineer of York, Pa., died there on June 16, at the age of 57. For approximately 19 years, Mr. Ramage was with the Filghman Moyer Co., of Allentown, Pa., as chief engineer and general superintendent of construction. He then became connected with Wigton-Abbott Corp. and Mahony-Troast Construction Corp., a joint venture for construction work at the Naval Supply Depot, Bayonne, N.J. He was a Lafayette College graduate.

William Ryan (Assoc. M. '30) supervisor on the Washington shore of the Corps of Engineers project at McNary Dam, Ore., died in an automobile accident on May 20. He was 58. Mr. Ryan graduated from the University of Notre Dame in 1914. After service in the Field Artillery of the Army during World War I, he became connected with several major oil companies. In 1928 he was engaged by the City of San Francisco, Calif., as construction engineer of highways, streets, and sewers. He had also been a construction engineer with Fred J. Early, Jr., consultant of San Francisco.



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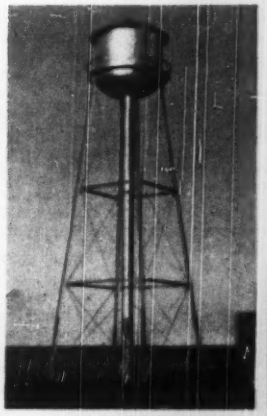

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NEWS OF Engineers

Ralph E. Spaulding (M. '18) former president of the Associated Industries of Florida, Inc., died in Los Angeles, Calif., recently at the age of 65. Mr. Spaulding received his engineering training at the Worcester Polytechnic Institute and for many years was associated with the Fred T. Ley Construction Co., New York, on construction work in Europe and South America. Upon his return to the United States, he organized the North American Construction Co., Miami, and later formed Aetna Iron & Steel Co., and the Aetna Steel Construction Co., Jacksonville, which he served as president from 1936 to 1947.

Alexander Shannon Templeton (Assoc. M. '47) engineer for Midland Constructors, Inc., Miami, Fla., died recently. He was 47. During his career Mr. Templeton was connected with the Texas Power & Light Co., the Texas Highway Department, the Tennessee Valley Authority, the Public Works Administration, and E. I. du Pont de Nemours, Inc. He also engaged in private practice for a short time. He attended the University of Texas.

William Jacy Titus (M. '28) division highway planning engineer of the Bureau of Public Roads at St. Paul, Minn., died on July 13, at the age of 65. Mr. Titus spent his engineering career in the field of highway design, construction, and administration. Before entering the service of the Bureau of Public Roads in 1933, he had been employed for 14 years by the Indiana Highway Commission—six years as state bridge engineer and 8 years as chief engineer. He received an A.B. degree in mathematics from Indiana University in 1909 and a professional civil engineering degree from the University of Wisconsin in 1913. He was a past-president of the Northwest Section of the Society, and a member and past-president of the Indiana Engineering Society.

William J. Titus

Henry Rigby Watson (Assoc. M. '45) civil engineer and chief of the Irrigation Practices and Operations Section of the Missouri-Oahe District of the Bureau of Reclamation, died in Huron, S. Dak., on May 22, at the age of 42. Mr. Watson had been in government service since 1941 on various assignments, including that of project engineer for the Soil Conservation Service on the Angostura project—first of the Missouri development projects to be completed. Previously he served as a member of the Utah State Planning Board and as civil engineer for the Board of Canal Presidents in Utah. He was educated in Utah universities.

[*Editor's Note:* Attention has been directed to an important omission from the obituary of **Hugh Browning Holmes** in the July issue. For 17 years Mr. Holmes was with the Kansas City, Mexico & Orient Railway.]

Lenox R. Lohr, president of the Chicago Museum of Science and Industry, has just been appointed Illinois Director of Civilian Defense by Governor Stevenson.

Richard M. Anderson, previously on the staff of the Stanolind Oil & Gas Co., Odessa, Tex., has become connected with the Subsurface Engineering Co., in the capacity of West Texas district manager, with headquarters at Midland.

H. P. Boardman, professor emeritus in the department of civil engineering at the University of Nevada, received an honorary doctor of science degree from the university during the recent commencement season.

Orris Bonney, formerly chief deputy engineer in charge of sewers, Columbus, Ohio, has been made head of the newly created Division of Sewerage and Drainage there.

Clinton B. F. Brill has accepted the position of special consultant to the firm of DeLeuw, Cather, Chicago consulting engineers, in the New England area, with headquarters in New York City. In this capacity Mr. Brill will also handle the Central and South American interests of the concern. He was formerly an architect with R. B. O'Connor & W. H. Kilham, of New York. A veteran of the second World War, he is executive officer of the 411th Engineer Brigade (Aviation).

Howard J. McCrodden, formerly designing engineer for the Raymond Concrete Pile Co., of New York, N.Y., is now associated with the Roane-Anderson Co., at Oak Ridge, Tenn.

Miles N. Clair has been elected president of the Thompson & Lichtner Co., Inc., of Brookline, Mass. Mr. Clair has been serving as vice-president of the organization.

Aldrich Durant, engineer of Cambridge, Mass., has been named chairman of the Cambridge Planning Board, succeeding **Prof. Frederick J. Adams,** of the Massachusetts Institute of Technology.

W. H. Hudson, Jr., has accepted the post of chief engineer of the St. Louis Southwestern Railway Lines, vice **W. S. Hanley** who recently retired. He will have headquarters at Tyler, Tex.

Clifford C. Hull, for the past six months acting Fresno County (California) road commissioner, has been named commissioner of public works of Fresno.

Melvin W. Jackson has become an assistant professor of civil engineering on the staff of the University of Colorado. Formerly Professor Jackson taught at Georgia Institute of Technology.

Andrew G. Bisset, rear admiral, CEC, USN, and district supply engineer of the Fifth Naval District, of Norfolk, Va., has retired after a Navy career of more than 30 years.

Louis G. Mertz, construction engineer, Broadway Realty Corp., New York, N.Y., is now supervisor of construction for Webb & Knapp, Inc., of that city.

Conrad W. O'Connel, until recently executive manager of the investment division of the Albert Stavitsky Co., Newark, N.J., has been appointed manager of the Syracuse division of the New York Water Service Corp.

Gordon H. Profitt has been named sales representative for the Nickel Cadmium Battery Corp., with offices in San Francisco, Calif.

Francis L. Brown recently resigned as deputy superintendent of the New York State Department of Public Works at Albany to establish an office for the practice of consulting engineering in New York City. Previous to his state service, Mr. Brown was a member of the firm of McFarland & Brown. During World War II he served for five years with the Civil Engineering Corps of the Navy and was released to inactive duty with the rank of commander.

Francis L. Brown

Lawrence J. Lincoln has assumed new duties as district engineer of the Kansas City (Kans.) District of the Corps of Engineers, where he will have charge of flood control and river development work for the region. In addition, Colonel Lincoln will have supervision of the maintenance and improvement of the Missouri River channel from Rulo, Nebr., to the river mouth above St. Louis, Mo., and the construction of agricultural levees along both banks of the river. He served the Corps in the Asiatic and Pacific theaters during the recent war, and in 1948 was engaged by the AEC on the atomic tests at Eniwetok.

Arthur I. Rezin, who has been employed as engineer on the staff of the Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis., is now with the Tennessee Valley Authority at the Hydraulic Laboratory in Norris, Tenn.

A. B. Ritter, since 1926 regional engineer with the Louisiana State Health Department, has become acting chief of the section of insect vector control and state director of malaria control.

Karl R. Kennison, is retiring as chief engineer of the Construction Division of the Metropolitan District Commission, Boston, Mass., after many years with the organization. During his tenure as chief engineer, such important works as the Quabbin Water Supply Project and the Hultman Aqueduct were completed. Mr. Kennison will engage in consulting work, specializing in problems in the general field of hydraulic engineering. For the present his address will be 28 Byfield Road, Wabun, Mass.

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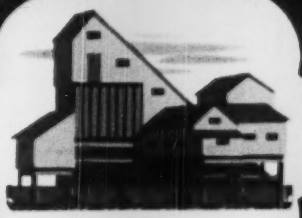
Continental Oil Bldg., Denver, Colo.
ON THE WEST COAST—The California Wire Cloth Corp.
1080—19th Ave., Oakland 6, Cal.

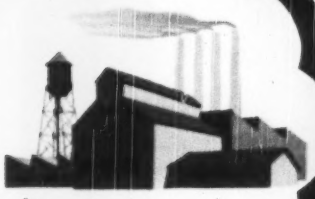
LOGGING

TRANSPORTATION

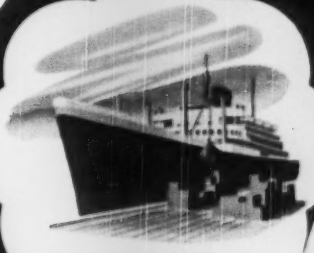


MINING

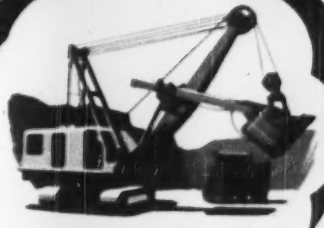
PETROLEUM



MANUFACTURING



MARINE



CONSTRUCTION

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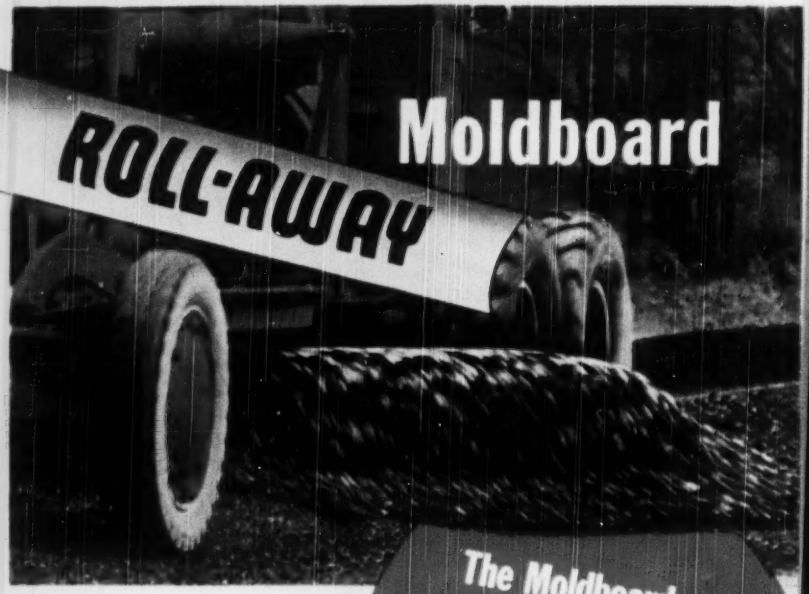
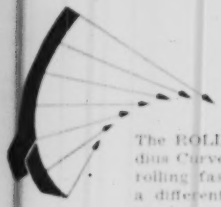
Less Power Effort





The ROLL-AWAY Moldboard has an Involute or Variable Radius Curve that lifts material up and moves it away in an easy, rolling fashion. Each part of the blade forces material toward a different point instead of a fixed point — prevents packing, power waste and drag on the entire machine. Material moves WITH an Allis-Chalmers Motor Grader — not against it!

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Model	Brake Hp.	Weight
AD-4	104	22,140 lb.
AD-3	78	21,825 lb.
BD-3	78	19,042 lb.
BD-2	50.5	17,772 lb.
D	34.7	8,500 lb.

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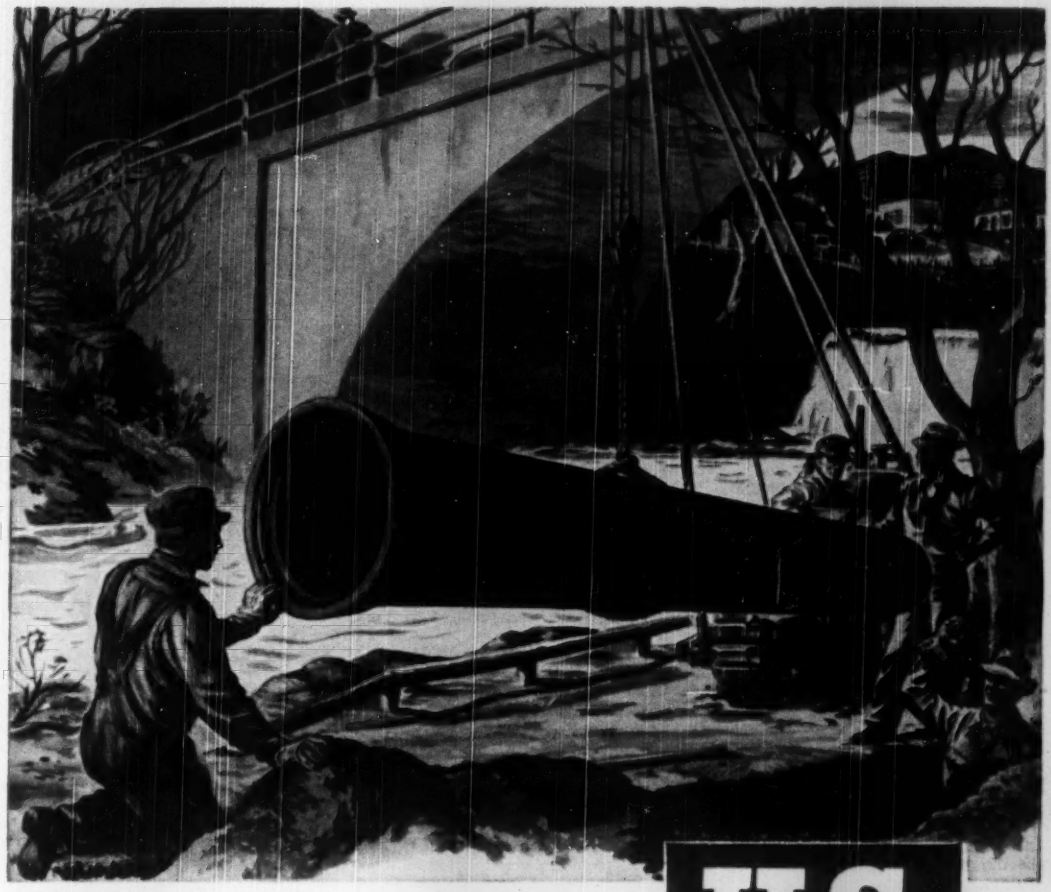

Painted for U. S. Pipe & Foundry Co. by Paul Laune

U.S. PIPE

IMAGINE that you have just heard about cast iron pipe for the first time! Would you not be eager to buy some? For what other pipe material used in constructing underground mains is as inexpensive to maintain? What other pipe material has a proved service record of over 100 years in city streets? What other pipe material has all the strength factors of long life that should be required of pipe to be laid in city streets? Our product has lived up to the best traditions of cast iron pressure pipe for 51 years. **United States Pipe and Foundry Co., General Offices: Burlington, New Jersey, Plants and Sales Offices Throughout U. S. A.**

James E. Jones has retired as hydrologic engineer for the Los Angeles Department of Water and Power after 41 years of service.

D. P. Krynine announces the formation of a consulting engineering practice, with offices in San Francisco, Calif. His work will be in the field of soil mechanics, foundations, earth structures, and allied subjects. Professor Krynine was on the staff of the University of California for the past two years, and at Yale University as professor of soil mechanics from 1929 to 1948.

Ray K. Linsley, Jr., formerly head of the hydrologic branch of the U. S. Weather Bureau, Washington, D.C., has been made associate professor of hydraulic engineering at Stanford University, succeeding **Leon B. Reynolds,** who recently retired.

Francis J. Magnuson is now city engineer of New Ulm, Minn. Previously, Mr. Magnuson was assistant superintendent of construction and repair for St. Paul.

Harry B. McBirney has retired as head of the Canal Division of the Bureau of Reclamation, at Denver, Colo. For nearly a quarter of a century, Mr. McBirney has directed design of western canals, laterals, and small diversion dams. While design engineer on the Boise project, he developed new and more economical types of canal structures and was largely responsible for the standardization of such designs for the Bureau. **A. B. Reeves** will become acting head of the division.

Harry B. McBirney

William P. Gardiner is now executive officer of the Little Rock, Ark., District of the Army Corps of Engineers.

Ambrose B. Brown, who has been in charge of the Bureau of Public Roads office at Government Island, Calif., has retired after 31 years of service. Some years ago Mr. Brown superintended construction of facilities on the island.

OUTGOING PRESIDENT of Engineering Institute of Canada, John E. Armstrong of Montreal (left), congratulates incoming president James A. Vance, of Woodstock, Ont., during recent joint EIC-ASCE meeting in Toronto. Both are ASCE members.

Arthur R. Reitter has been appointed city engineer of Lincoln, Calif., on a part-time basis. He is also city engineer of Colusa and Williams.

Frederick C. Schlemmer, who recently resigned as manager of the AEC's Hanford (Wash.) Works, has been appointed manager of construction of Burns & Roe, Inc., engineers and constructors of New York City.

S. S. Steinberg, dean of the University of Maryland College of Engineering, has accepted an appointment as chairman of the Committee on Education of the President's Conference on Industrial Safety.

Henry Walsh, previously assistant division engineer for the North Atlantic Division of the Corps of Engineers in New York City, has assumed new responsibilities as district engineer at Nashville, Tenn.

Harold A. Linke, formerly state engineer of Utah, has formed a partnership with **Win Templeton,** Salt Lake City consultant, under the firm name of Templeton & Linke, with offices in that city.

Harmer E. Davis, director of the Institute of Transportation and Traffic Engineering at the University of California, has been named chairman of the Highway Research Board's Committee on Highway Organization and Administration. The purpose of this committee is to study the organization and management of highway activities on all government levels. Other ASCE members on the committee include **Hal H. Hale,** executive secretary, American Association of State Highway Officials; **G. Donald Kennedy,** consulting engineer and assistant to the president of the Portland Cement Association; **Ben H. Petty,** professor of highway engineering, Purdue University; and **L. S. Tuttle,** assistant to the commissioner of the U.S. Bureau of Public Roads.

L. F. Harza, president of the Harza Engineering Co., of Chicago, and **S. O. Harper,** retired chief engineer of the Bureau of Reclamation, have been appointed members of the consulting board of the Damodar Valley Corp., of Calcutta, India, to review a number of proposed hydroelectric, flood control, and irrigation projects on the Damodar River and its tributaries. The Damodar Valley Corp. is a government group under the direction of **S. N. Mozumdar. Franklyn C. Rogers,** professor of civil engineering, Rutgers University, has been granted a leave of absence to take charge of the Maithon hydroelectric project, near Ranchi, Bihar, a project of the Damodar Corp.

Sam Floyd Warren, formerly district engineer, Portland, Ore., District, of the Engineer Corps, has been transferred to Detroit Dam for training and observation of construction of the North Santiam River project.

Ralph M. Weaver is now employed by the Tennessee Valley Authority at its Hydraulic Laboratory, Norris, Tenn.

Frederick H. Weed, for the past four years engineer in charge of planning and developing the new Miami, Fla., metropolitan water system, has become an associate in the firm of Buck, Seifert & Jost, New York City consulting engineers. An authority in the field of sanitary and power engineering, Mr. Weed was chief of the Water Supply Section of the War Production Board's Water Division during World War II.

The many friends of ASCE Past-President **E. M. Hastings** will be happy to hear of his recovery from a serious illness that hospitalized him during the winter and early spring. Mr. Hastings is now able to go daily to the Richmond headquarters of the Richmond, Fredericksburg & Potomac Railroad, which he has served as chief engineer for a number of years. Mr. Hastings was ASCE Vice-President in 1943 and 1944 and President in 1947. He has received many tokens of appreciation from students at Virginia Military Institute, where he has long served the Student Chapter as Contact Member.

E. M. Hastings

Harold E. Butcher and **Charles M. Carter** have joined the staff of the Engineering and Maintenance Division of the Oak Ridge National Laboratory, Oak Ridge, Tenn.

Annual Meeting of ASCE
Chicago, Ill.
Congress Hotel, October 11-14, 1950

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Other .....

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Steel Sheetpile Cells Form Long Beach Harbor Bulkhead

(*Continued from page 29*)

low water, the 27-in. dredge *San Diego*, owned by Pacific Dredging Co., was necessarily equipped with a special 105-ft extension to its ladder.

The construction of Unit No. 2 Pier A East has required careful coordination of the several contracts for specialized work so that each operator could conduct his work with a minimum of delay. Much credit is due the staffs of each contractor and the inspection staff of the Harbor Department for the effective cooperation.

The project was designed by the Port of Long Beach Engineering Department under the direct supervision of B. N. Hoffmaster, Structural Engineer, with R. R. Shoemaker, Chief Harbor Engineer. The field work, survey work and inspection, as well as coordination and administration of the contracts, was done under the supervision of C. L. Vickers, Assistant Harbor Engineer. Carol Glenn was general superintendent for the Guy F. Atkinson Co., Don Strange for the Livingston Truck and Materials Co., John Connolly for Connolly-Case-Kiewit, and C. R. McCoy for the Pacific Dredging Co. Work on the entire project was initiated on June 10, 1949, and completed approximately on June 30, 1950. The driving of the 44 circular cells was started in September 1949 and completed in March 1950.

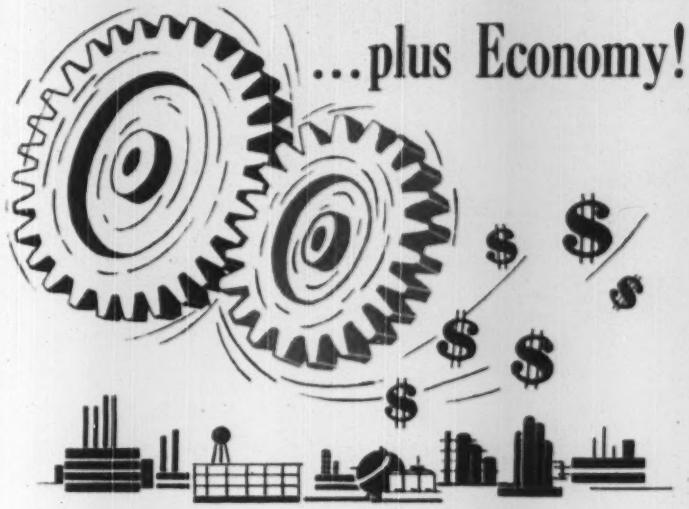
The helpful advice of V. P. Weismann, the engineering representative of Bethlehem Pacific Coast Steel Corp., was available at all times. Prior to undertaking the project, a general subsurface soil exploration of the site and other adjacent areas was made, with Raymond Concrete Pile Co. and George Casey doing the drilling, and L. T. Evans, foundation engineer, the laboratory work.

New Publications

Air-Entrained Concrete. The best prevailing practices in the use of air-entrained concrete in pavements and bridges are described by the Highway Research Board in a revised edition of No. 13 in its Current Road Problems series, originally published in 1946. Designated No. 13-R, the present edition includes the most widely accepted methods of test and control and latest specifications of the ASTM. Inquiries should be addressed to the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

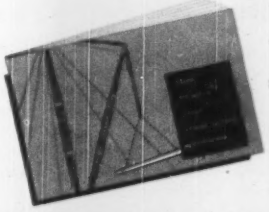
Construction Films. To assist persons in the building field in preparing meeting

Fast Action ...plus Economy!



M-C & S is geared to meet today's construction needs!

From the moment a project is assigned to Merritt-Chapman & Scott, you can count on *action*. Working in close harmony with you, M-C & S brings its specialized skills and unrivalled facilities to bear on the job. Merritt-Chapman & Scott project managers possess the experience and ingenuity that assure fast, on-the-spot solutions whenever unexpected problems arise. Examples of M-C&S's ability to complete various types of projects as designed, on time, are contained in the illustrated brochure offered below.



New booklet presents a factual record of M-C & S's ability to solve the most challenging construction problems. Your copy will be sent immediately upon request to Dept. C3.

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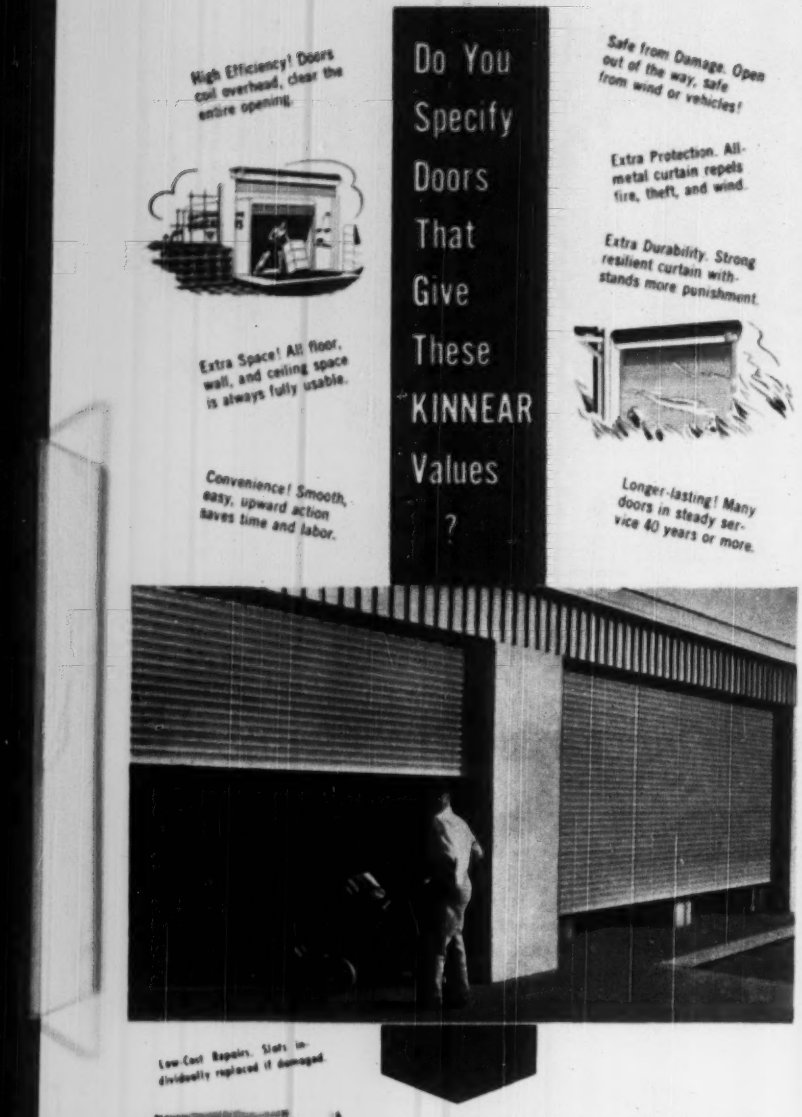
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Do You Specify Doors That Give These KINNEAR Values ?
Safe from Damage. Open out of the way, safe from wind or vehicles!
Extra Protection. All-metal curtain repels fire, theft, and wind.
Extra Durability. Strong resilient curtain withstands more punishment.
Extra Space! All floor, wall, and ceiling space is always fully usable.
Convenience! Smooth, easy, upward action saves time and labor.
Longer-lasting! Many doors in steady service 40 years or more.
Low-Cost Repairs. Slats individually replaced if damaged.
Any Size! Each door built to meet individual requirements.

Kinnear Rolling Doors are easily equipped with Kinnear Motor Operators for highest convenience and efficiency. Pushbutton controls can be provided at any number of convenient points — a feature that not only saves manpower but also reduces heating and air-conditioning costs by encouraging prompt door closure. Every door is specially fitted to the individual opening. Easily installed in new or old buildings. Write for details and estimate on your door requirements.

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KINNEAR ROLLING DOORS

programs for professional groups, the Producers' Council, Inc., has prepared a 24-page bibliography of construction films available from building product manufacturers. All films listed are available to professional groups without charge. Industrial organizations may obtain single copies of the bibliography by writing the Council's national office at 815 Fifteenth Street, Washington 5, D.C.

Welding. Issuance of a new circular (No. 51) containing information on published works on welding and contributing fields is announced by Ohio State University. Requests for Circular 51 should be addressed to the Department of Welding Engineering, Ohio State University, Columbus, Ohio.

City Planning. Detailed studies of land use in the Philadelphia Metropolitan area in 1944, made by the Philadelphia City Planning Commission, are reported in Planning Study No. 3 recently released by the Commission. Inquiries concerning the report which includes many maps, charts, and tables, should be addressed to the Philadelphia City Planning Commission, Market Street National Bank Building, Philadelphia 7, Pa.

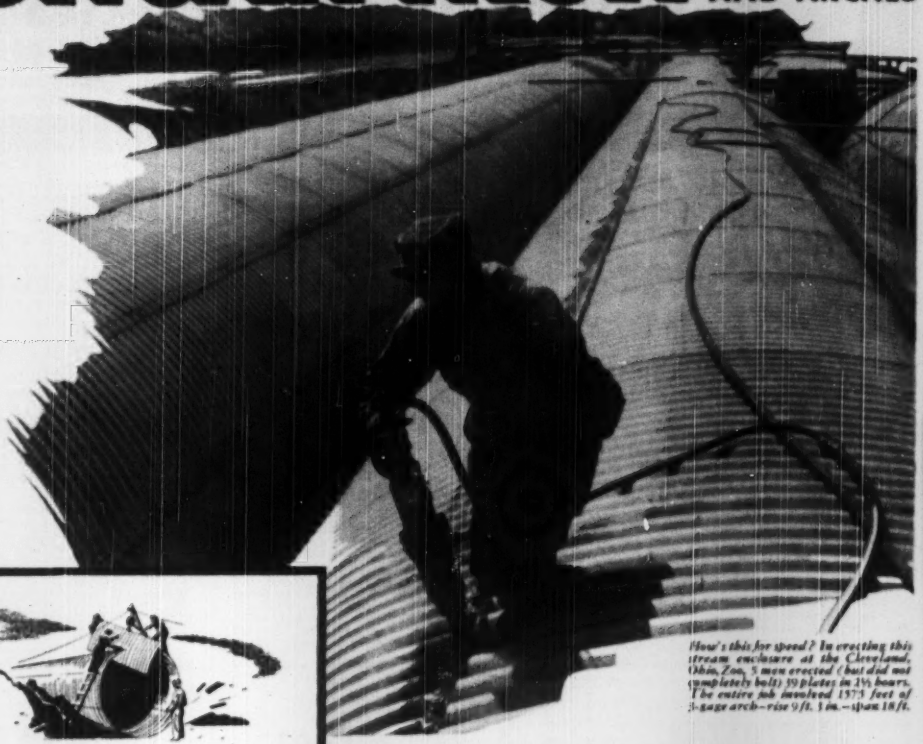
Highway Studies. The 1949 work of the Highway Research Board's Committee on Load Carrying Capacity of Roads as Affected by Frost Action is reviewed in Research Report No. 10-D, which has been made available by the Board. Also included in the report are the activities of the eight states cooperating in the project and contributing research data and a manual of procedure for conducting field plate-bearing tests. Address inquiries to the Highway Research Board, Washington 25, D.C.

Nickel Alloys. Two new technical bulletins on the properties of high nickel alloys have been released by the International Nickel Co., Inc. These are Technical Bulletin T-7, entitled *Engineering Properties of Inconel*, and Technical Bulletin T-9 dealing with the engineering properties of "K" Monel and "KR" Monel. Both 24-page publications contain charts, tables on compositions and properties, working instructions, and other technical information. They are available without charge from the Technical Editor of the International Nickel Co., Inc., 67 Wall Street, New York 5, N.Y.

Mapping. A new five-color information folder on topographic maps, prepared by the U.S. Geological Survey, is now available as a free public service from the Director of the Survey, Washington 25, D.C. Parts of a projected atlas of 15-min topographic quadrangle maps may be purchased at 20 cents a quadrangle from the Survey.

Sanitary Engineering. Current sewage-works practice in the United States is summarized in Supplement 213 to Public Health Reports of the Public Health Service. Entitled *Statistical Summary of Sewage Works in the United States*, by John R. Thoman, Jun. M.ASCE, the publication is intended to serve as a record from which future trends may be developed. Copies are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at 10 cents each.

TONCAN IRON SECTIONAL PLATE PIPE AND ARCHES



How's this for speed? In erecting this stream enclosure at the Cleveland, Ohio, Zoo, 5 men erected (but did not completely bolt) 19 plates in 1½ hours. The entire job involved 1575 feet of 3-gage arch—rise 9 ft. 5 in.—span 18 ft.

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1. Shipped "knocked down", plates and bolts arrive in one lot—are easy to handle—save freight and local hauling costs.

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4. Then—the *most important* advantage: Toncan Iron outlasts all other ferrous metals in its price class. It is an alloyed iron—containing double the copper in copper-bearing steels and irons, *plus* just the right amount of molybdenum to make the copper most effective.

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CIVIL ENGINEER: Jun. M. ASCE; 24; veteran; married; B.C.E., 1949; experience in field engineering summer months 1942-1944, 1946-1949; 1 year civil engineering with TVA field engineers doing steam plant construction. Drafting and office experience. Interested highway and airport construction, water and sewage installations, contracting, photogrammetry leading to consulting career. C-619.

CIVIL ENGINEER, recent graduate; Jun. M. ASCE; 21; seeks position in New York vicinity. Field work preferred. Résumé furnished upon request. C-620.

CIVIL ENGINEER: Jun. M. ASCE; 25; veteran; married; B.S. in C.E. cum laude; M.S. in C.E. (soil mechanics) Harvard, 1950. Experienced in survey, highway, and bridge construction. Desires position in soils, foundations, any location. C-621.

CIVIL ENGINEER: graduate; Jun. M. ASCE; 28; married; veteran; commercial pilot's license; desires position in construction work; willing to travel in United States. C-622.

CIVIL ENGINEER: Assoc. M. ASCE; 33; veteran; married; advanced degrees, structural and hydraulic; registered in territory of Alaska; 7 years' experience, principally field work and heavy construction, some office work; desires position offering responsibility, diversified experience; prefers western United States; salary dependent on duties and location. C-623.

CIVIL ENGINEER: Jun. M. ASCE; B.S. in C.E.; 28; married; veteran; registered civil engineer, Kentucky; 7 years' experience design and construction of various type structures. Architectural experience and engineering office work. Desires permanent employment with engineering or construction firm. Field or office. East Coast or Midwest. C-624.

CIVIL ENGINEER: Jun. M. ASCE; B.S. in C.E., Purdue University; 24; married; registered, Indiana, Puerto Rico; 27 months' responsible charge construction and maintenance of roads, buildings and irrigation structures on 6,000 acres of cane land, design planning, and supervision. Knows irrigation layout, surveying; speaks Spanish; location optional. C-625.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Positions Available

ENGINEER OF TESTS to take charge of commercial structural tests at a university laboratory. Will assist director with research tests, supervision of mechanics, machine shop, accounts, etc. Prefer man with some laboratory experience. M.S. degree and professional license desirable. Opportunity for work towards master's or doctor's degree. Salary, $3,600-$3,900 a year including one month vacation. Location, eastern Pennsylvania. Y-3741.

ENGINEERS. (a) Resident Engineer, 40-50, with New York State license, and at least 10 years' supervisory engineering experience in heavy construction and steel bridge work, to be resident engineer on bridge and highway project. (b) Field Engineer, under 45, with at least 5 years' heavy construction and steel bridge experience to be responsible for line and grade, plant interpretation, procedures, etc., on bridge project. Salary, $4,800-$5,200 a year. Location, New York metropolitan area. Y-3804.

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wanted for work in Brazil. Age 28 to 40. By North American Company which has been building hydro-electric projects in Brazil for past 50 years. First class engineering and construction organization with good opportunities for future. Salary to suit qualifications. In reply state experience and personal status in detail. Reply to Dept. WHK Canadian Brazilian Services, Ltd., Yonge & Gerrard Sts., Toronto, Ontario, Canada.

STRUCTURAL DESIGNER WANTED

Structural designer C.E. graduate major in structural design with 3 to 5 years experience in design of steel and reinforced concrete structures, experience in structural design in oil refineries or chemical industry desired.

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College graduation with supervisory experience or high school graduation with extensive experience required. To verify estimates, establish program of work and coordinate work of crafts and requisition of materials in connection campus maintenance, landscaping, drainage, lawns, shrubbery, parking areas, walks, paths, and woodlands. Minimum age 25. Permanent position with paid vacation and sick leave, retirement, hospitalization and educational benefits available. 3600-5400 per year. Apply University of Illinois, 809 South Wright St., Champaign, Illinois.

RESIDENT ENGINEER, 28–40, civil, electrical, or mechanical degree, with at least 2 years' experience supervising construction in the field; also 1 year of design experience. Salary, $5,000–$6,500 a year. Location, upstate New York. Y-3847.

ASSISTANT PROFESSOR OR INSTRUCTOR, civil graduate, preferably with graduate work and practical experience, to teach sanitary engineering. Salary, $3,000 a year minimum. Location, New York, N.Y. Y-3876.

WATER CONSULTANT, degree in chemical, sanitary, or civil engineering. If the latter, should have majored in sanitary engineering courses. 8 to 10 years' experience in jobs being responsible for water purification treatment, including boiler-feedwater treatment. Should also have operated filter plants and be familiar with water softening iron exchange. Location, Delaware. Y-3897.

CODE WRITER, civil graduate, experienced in building construction and experience with various building codes, to write, correlate and develop a new state building code. Salary, open. Location, Midwest. Y-3920D.

ENGINEERS. (*a*) Civil Engineer experienced in a wide range of construction materials and processes for special-purpose buildings. Must be able to supervise design, specifications, etc., for general utilities services and access roads and railroads. (*b*) Civil Engineer, structural, experienced in the structural design of special-purpose buildings using a wide range of materials. Must be familiar with construction requirements for furnishing of utilities in unusual quantities. (*c*) Civil Engineer, sanitary, experienced in applying modern techniques for water treatment to both sani[illegible] and process water supplies for large special-purpose laboratories. Must have some experience in making economic studies for the efficient handling of a widely varying demand. Should be familiar with operation and maintenance of pumping stations. Location, Tennessee. Y-3932.

CHIEF ENGINEER, under 55, with considerable experience in heavy construction for large concrete and steel chemical plant located in South America. Elevation 10,000 ft. Knowledge of Spanish desirable. Salary, $10,800–$12,000 a year. Y-3964.

ASSISTANT CHIEF ENGINEER, civil, preferably under 45, with broad experience in the field of designing belt conveyors for handling bulk materials such as coal, coke, limestone, and aggregates for manufacturer of heavy materials conveying equipment. Knowledge of plant layout and assembly of structures and equipment into an efficient scheme is required. Salary commensurate with ability. Location, New York, N.Y. Y-3974.

PROJECT ENGINEER (2), 35–45, preferably with mechanical or civil degree, and minimum of 10 years' experience in engineering and construction in the pulp and paper industry. Must have thorough knowledge of pulp and paper process and equipment, of design and drafting room procedure; and of estimating equipment installation and building construction. Must be able to plan the layout and design for construction of buildings and for installation of equipment and machinery used in the pulp and paper industry. Salary, $7,500–$10,000 a year. Location, New England. Y-3994.

CIVIL ENGINEER, graduate, 35–40, with about 10 years' experience in the design of water-front facilities, such as piers, bulkheads, etc. Some experience with tank foundations and pump stations desirable, but not necessary. Work will be on the design of bulk terminals. Salary open. Excellent opportunity. Location, New York, N.Y. Y-4003.

DESIGN ENGINEER with at least 10 years' highway design, planning, layout, specification experience, to take charge of design of urban and rural projects. Must have considerable New York State experience and license. Salary, $10,000 a year. Location, New York, N.Y. Y-4009.

ASSISTANT SUPERINTENDENT, 30–40, civil graduate, with railroad construction and maintenance experience, to supervise improvements, relocations, make hydrological surveys, plan stream diversions, including pipeline work, etc., for mining company. Knowledge of Spanish very desirable. Salary, $4,800–$6,000 a year. Three-year contract. Location, west coast of South America. Y-4020.

CIVIL ENGINEERS, for design and inspection of large municipal water works and housing projects. Salary, dependent upon experience. Location, Michigan. D-5975.

ARCHITECTURAL ENGINEERS, for design and inspection of large municipal water works and housing projects. Salary dependent on experience. Location, Michigan. D-5976.

ENGINEERS. (*a*) Structural Designer, graduate, 30–40, 3 or more years' experience required in design of structural steel and reinforced concrete for oil refineries or chemical plants. Will do structural design, estimating, and take-off work for oil refineries and equipment. Salary open. (*b*) Architectural Detailers, architect or architectural engineering, 30–40, three or more years' detailing architectural work for oil refineries or chemical

(*Continued on page 90*)

Projects PR-2 and PR-2A

GOVERNMENT OF PUERTO RICO

DEPARTMENT OF THE INTERIOR

BUREAU OF BUILDINGS

SANTURCE, PUERTO RICO

Date July 15, 1950

ADVERTISEMENT

Sealed proposals will be received by the Commissioner of the Interior of Puerto Rico at his office, Santurce, Puerto Rico, until 2:00 P.M. on October 20, 1950, and then be publicly opened and read aloud, for furnishing all plant, labor, and materials and performing all work required for THE CONSTRUCTION OF VARIOUS BUILDINGS FOR THE INSULAR PSYCHIATRIC HOSPITAL AT RIO PIEDRAS, PUERTO RICO.

Prospective bidders may submit bids for any one or all or any combination of the following Contract Areas as indicated on the Site Plat:

Contract Area I

1—Building "A"—Administration and Reception Building

Contract Area II

1—Building "B"—Tuberculosis Building

Contract Area III

1—Building "C"—Chronic Disturbed Building—Men
2—Building "D"—Chronic Disturbed Building—Women
3—Building "F"—Industrial Patients Building—Men
4—Building "G"—Industrial Patients Building—Women
5—Building "H"—Industrial Patients Building—Women
6—Building "J"—Inactive Patients Building

Plans, specifications, and all pertinent contract documents may be obtained at:

1—Department of the Interior—Santurce, Puerto Rico
2—Office of Puerto Rico, 1026 17th Street, N.W., Washington 6, D. C.
3—Office of Puerto Rico, 1881 Broadway, New York, N. Y.

upon deposit in cash, money order, or certified check payable to the Commissioner of the Interior of Puerto Rico in the amount or amounts indicated below:

1.	Complete Plans and Specification	$225.00
2.	Architectural Section & Specification	$ 90.00
3.	Structural Section & Specification	$ 55.00
4.	Mechanical Section & Specification	$ 80.00

The full amount of the deposit or deposits will be refunded to the depositor upon return of the above documents in good condition within a period of THIRTY (30) DAYS after the date of the opening of bids.

Each proposal must be accompanied by a provisional bond in cash, bid bond, or certified check payable to the Commissioner of the Interior of Puerto Rico for not less than the amounts indicated in the proposal form.

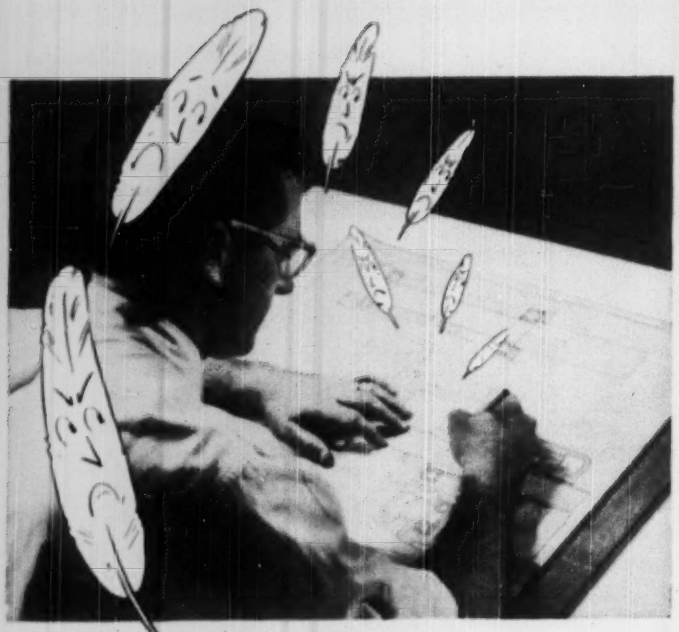
Special attention is called to the bidders that plans, specifications, and contract documents may be obtained only up to Sept. 30, 1950, and that any bid which does not contain the prices written in letters and figures will be rejected.

The Board of Awards reserves the right to reject any or all bids and to waive informalities.

Engineer's Estimate

Contract Area I	$1,050,000.00
Contract Area II	500,000.00
Contract Area III	1,625,000.00

JORGE J. JIMENEZ
Commissioner of the Interior



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plants. Duties will include architectural detailing on oil refineries, structures and buildings, for a refinery. Salary open. (c) Plant Evaluation Engineer, mechanical engineering and business administration; 26–40, 2 years' experience required. Office experience and should know something about accounting and law. Will work from records, making contacts to refineries and doing plant evaluation work. About half of time will be spent traveling for a refinery. Salary, $275–$300 a month. Location, Illinois. R-6646.

STRUCTURAL ENGINEER, C.E. desirable, 10 years' experience required on reinforced concrete and structural steel for continuous forms, reservoirs, and underground and filter work. Will take charge of structural design section on filtration equipment and plant. Salary, $6,600 a year. Location, Illinois. R-6666.

SANITARY ENGINEER, graduate civil engineer, knowledge of and training in sewage treatment, water purification, and industrial wastes. Will engage in office and field work. Salary, approximately, $250–$450 a month. Location, Illinois. R-6665(c).

CHIEF ENGINEER, 40–45, civil graduate, with at least 15 years' experience on design, construction, administration of city water supply and sewage system, including water treatment, distribution, sewage disposal, records, costs, public relations, and comprehensive supervisory work. Salary, $10,000 a year. Location, East. Y-4061.

Meetings and Conferences

American Public Works Association. The annual public works congress and equipment show, sponsored by the American Public Works Association, will be held in New York City, October 15–18.

American Society for Metals. The annual meeting and exposition of the American Society for Metals will be held in the Chicago International Amphitheatre, October 23–27.

American Society of Mechanical Engineers. The fall meeting of the American Society of Mechanical Engineers will be held at the Hotel Sheraton, Worcester, Mass., September 19–21.

Federation of Sewage Works Associations. In conjunction with the Maryland-Delaware Water and Sewerage Association and the Federal Sewage Research Association, the twenty-third annual meeting of the Federation of Sewage Works Associations will be held at the Hotel Statler, Washington, D.C., October 9–12.

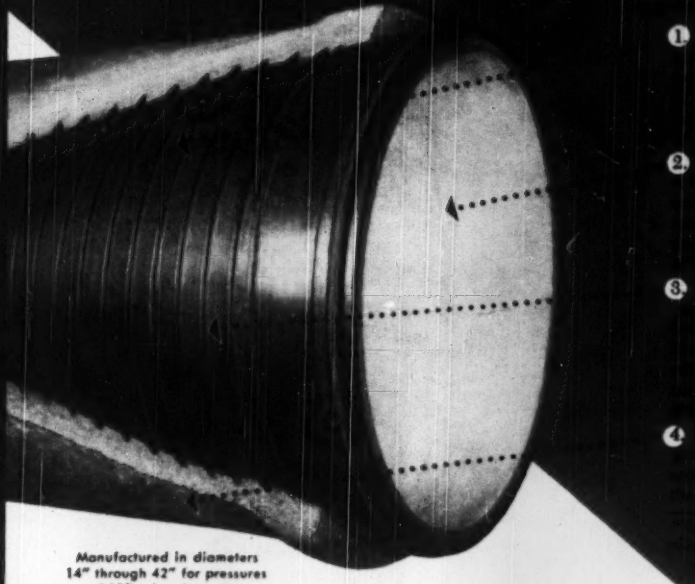
Institute of Traffic Engineers. Technical sessions and social events of the Institute of Traffic Engineers convention will take place at the Commodore Hotel, New York, N.Y., September 24–27.

National Conference on Industrial Hydraulics. Sponsored by the Armour Research Foundation of the Illinois Institute of Technology and the Graduate School of the Institute, together with seven technical societies, the National Conference on Industrial Hydrauiics will be held at the Sherman Hotel, Chicago, October 18 and 19.

National Safety Council. Various phases of safety will be discussed during the national safety congress and exposition of the National Safety Council, at the Stevens, Congress, and Morrison hotels, Chicago, October 16–20. Address inquiries to R. L. Forney, General Secretary, National Safety Council, 425 North Michigan Avenue, Chicago 11, Ill.

Pacific Coast Building Officials Conference. Headquarters for the Pacific Coast Building Officials Conference will be the Hotel Manor, San Diego, Calif., October 3–6.

THE DEPENDABLE STRENGTH OF AMERICAN CONCRETE CYLINDER PIPE IS A RESULT OF SUPERIOR DESIGN



Manufactured in diameters 14" through 42" for pressures of 100 psi and greater.

RUGGED TEST SHOWS IMPRESSIVE RESULTS

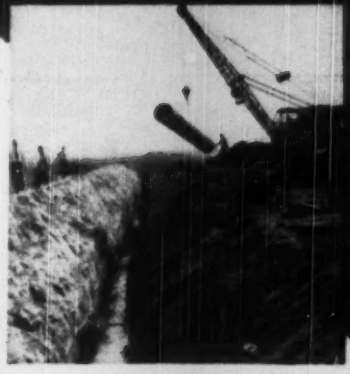
Practical tests recently conducted for the Underwriters' Laboratories, Inc. prove the remarkable strength of American Concrete Cylinder Pipe under earth loads which far exceeded the average trench conditions. Several sections of pipe were installed under 10 ft. of earth cover. The ordinary method of pipe bedding was employed and backfilling was accomplished by flooding the trench. Machinists' calipers were then used to measure changes in inside diameters at several points along each section of pipe. The average results were as follows:

	Vertical Diameters in inches	Horizontal Diameters in inches
42" Diameter Pipe	Minus .314	Plus .318
30" Diameter Pipe	Minus .052	Plus .050
21" Diameter Pipe	Minus .010	Plus .009

Subsequent examination of the concrete linings disclosed that they were sound and unimpaired under these extraordinary earth loads.

Superior design affords the most economical and effective use of steel and concrete to produce the best quality of pressure pipe at less cost to the purchaser. Economical first cost plus ease of installation, sustained capacity and trouble free service all help to reduce the cost of delivered water.

Complete information upon request.



Installing a section of 30" pipe prior to earth loading tests.

American PIPE AND CONSTRUCTION CO.

Concrete Pipe for Main Water Supply Lines, Storm and Sanitary Sewers, Subaqueous Pipe Lines

P.O. Box 3428, Terminal Annex, Los Angeles 54, California

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Positions Announced

U.S. Civil Service Commission. Announcement of examinations for engineers (Grades GS-9 and GS-11), for the Bureau of Reclamation in the West and Midwest with yearly salaries ranging from $4,600–$5,400, has been made by the U.S. Civil Service Commission. No written examination is required. In addition to four years of college training or its equivalent in experience, applicants must have specialized in one of the following branches of engineering: architectural, civil, construction, electrical, hydraulic (general), hydraulic (hydrologic investigations), materials, safety, or surveying and cartographic. Further information and application forms may be obtained from local post offices, civil service regional offices, or from the U.S. Civil Service Commission, Washington, D.C. Applications should be addressed to the Executive Secretary, Central Board of U.S. Civil Service Examiners, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Fifth Naval District. The Public Works Office of the Fifth Naval District is seeking applicants for the following positions: Engineer, GS-7, initial salary, $3,825 per annum; Engineer, GS-9, initial salary, $4,600 per annum; and Engineering Aide (Civil), GS-6 initial salary, $3,450 per annum. Inquiries should be addressed to the Public Works Office, Fifth Naval District, Norfolk 11, Va.

Government Loans Stimulate Public Housing Through Local Initiative

(Continued from page 22)

the proposed project. The plans and specifications and complete contract documents, prepared by the architects and engineers employed by the local authorities, are reviewed and approved by the PHA for conformance with the development program and the contract for financial aid. When approved, authority is granted by PHA to advertise and obtain lump-sum competitive bids.

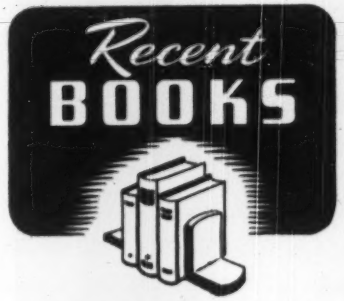
What the Act Is Designed to Do

Rents on completed dwellings are scaled to what the individual can pay. Since the rental revenue from the project is not enough to cover the cost of operation and debt service, the federal government makes up the deficit with a subsidy paid each year, known as the Annual Contribution. The local government also contributes to low rents by exempting the projects from taxation, but receives, in lieu of taxes, annual payments of 10 percent of shelter rent from the PHA, to pay for schools, water and sewer mains, streets and other civic services.

How this works out in practice is demonstrated by a typical slum-clearance and low-rent public housing pro-

gram in Milwaukee. A joint study by the Milwaukee Housing Authority and the city tax commission revealed that an average tenant, who formerly paid $24.68 per year in taxes, is now paying $30.00 as a payment in lieu of taxes to the city since he moved into a low-rent public housing project.

To the private investment resources of the nation, the Housing Act of 1949 offers the opportunity for profitable use of the vast accumulations of capital of the insurance companies, banks and other fiduciary institutions and industry backed by the guarantee of payment, if necessary, by the U.S. Government. To the manufacturers of building materials and construction equipment, it opens a market for generations of capacity production. To the private construction industry, it presents a task so vast that it dwarfs the war effort. To labor it gives assurance of year-round employment. All this is done while maintaining respect for the American tradition of home rule by giving full responsibility and initiative to the states and local communities.

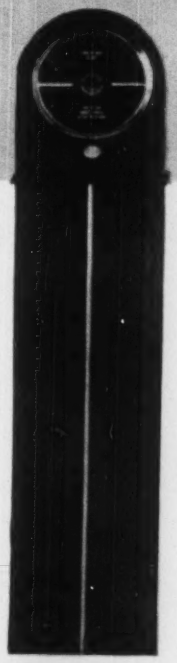


Books in the Engineering Societies Library may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains research and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

ASTM SPECIFICATIONS FOR STEEL FLAT PRODUCTS, sponsored by ASTM Committee A-1 on Steel. March 1950. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 508 pp., diagrs., tables, 9×6 in., paper, $2.25. Specifications pertaining to steel plate, sheet, and strip materials are brought together in this publication for convenient reference. They are broadly classified as follows: steel for structural purposes; steel for boilers and pressure vessels; corrosion-resisting steel; wrought iron plate and sheet; and metallic-coated iron and steel sheets. The usual numerical list is also included.

BASIC REINFORCED CONCRETE DESIGN. By G. E. Large. Ronald Press Co., New York, 1950. 334 pp., illus., diagrs., charts, tables. 9½×6 in., linen, $5.50. Using the problem method of instruction, this book contains a survey of the fundamentals needed by civil engineers in the understanding of reinforced concrete design. The appendix contains many useful charts and certain sections of the ACI Building Code.

HYDROLOGY, THE FUNDAMENTAL BASIS OF HYDRAULIC ENGINEERING. 2nd. revised and enlarged. By D. W. Mead. Mead and Hunt, Inc.,



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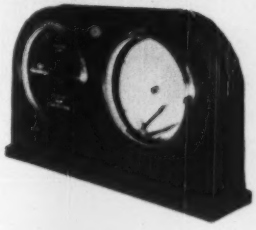
Simplex takes pleasure in introducing a brand new line of filter gauges . . . streamlined, sturdier, simplified, and even more accurate than before. These gauges have been especially designed for easy installation and long life with a minimum of maintenance.

Whether you wish to measure flow rate through a filter or from a wash water tank . . . or the loss of head across a filter . . . or to determine clear well or settling basin depths . . . or to visualize filter bed expansion—one of the available types will exactly suit your needs. These rugged, accurate gauges are useful too for the summation of flows at different locations.



Every consulting engineer should have our new free Bulletin 1000 in his file. It describes fully these new gauges and shows installations, types of mountings, dimensions, cross section cuts, etc. Just write to Simplex Valve & Meter Co., Dept. 9, 6724 Upland Street, Philadelphia 42, Pa.

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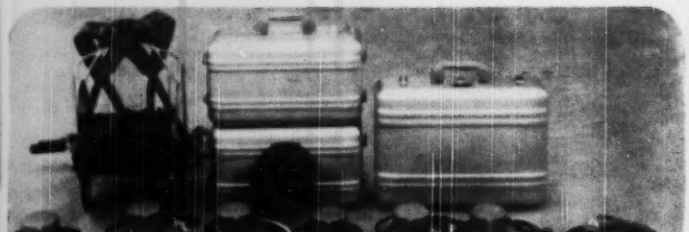

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McGraw-Hill Book Co., New York and London, 1950. 728 pp., illus., diagrs., charts, maps, tables, 9¼×6⅛ in., cloth, $7.50. Completely revised since its first publication in 1919, this standard text now also provides sections covering such recent developments as a discussion of the Bergeron analysis of meteorological phenomena in terms of air masses; a new approach to evaporation theory and methods of measurement; the new techniques and possible consequences of producing artificial rainfall; methods of weighing precipitation records; the application of the theory of probability to hydrologic data; and the application of statistical theory to flood frequency.

INDUSTRIAL MATERIALS HANDLING, original manuscript by C. H. Barker, Jr., revised and rewritten by I. M. Footlik, C. F. Yarham and J. F. Carle. Lincoln Extension Institute, 1401 West 75th St., Cleveland 2, Ohio, 1950. 381 pp., illus., diagrs., charts, tables, 8½×5½ in., linen, $4.75. A comprehensive and basic treatment of materials handling, based on information obtained from experts in all aspects of the field. Following a history and survey of the field, the fundamentals of materials handling operations are considered. Various types of equipment are then described in detail, and the problems of unit loads and plan layout are considered.

INTRODUCTION TO EXPERIMENTAL STRESS ANALYSIS. By G. H. Lee. John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London, 1950. 319 pp., illus., diagrs., charts, tables, 9¼×6 in., cloth, $5.50. Theory, instrumentation, and basic techniques are covered for the most commonly-used methods: Mechanical and electrical strain gages, with particular attention to the resistance-wire strain gage; the photoelastic method; brittle-lacquer techniques; the membrane and electrical analogies; and the Berry deformeter and other miscellaneous methods. The final chapter deals with the evaluation of experimental errors and the transmission of these errors through computational operations.

POCKET ENCYCLOPEDIA OF ATOMIC ENERGY. Edited by F. Gaynor. Philosophical Library, 15 East 40th St., New York, 1950. 204 pp., diagrs., charts, tables, 8½×5½ in., linen, $7.50. This book presents a comprehensive collection of brief explanations and definitions of concepts and terms in the field of nuclear physics and atomic energy. In addition, brief biographical sketches of outstanding workers in the field are included as well as descriptions of important nuclear research laboratories, power plants, and installations. German equivalents are given for a great many of the terms defined.

PRAXIS DER ABWASSERREINIGUNG. By W. Husmann. Springer-Verlag, Berlin, Göttingen, Heidelberg, 1950. 140 pp., illus., diagrs., charts, tables, 9×6 in., paper, 10.50 DM. This book surveys the various methods of residential and small industrial plant sewage purification. It discusses microorganisms, pH, flow, sludge, sampling, industrial controls, and industrial problems. Small home units are also described.

RECOMMENDED PRACTICES FOR RESISTANCE WELDING, C1.1-50. American Welding Society, 33 West 39th Street, New York, 1950. 60 pp., diagrs., charts, tables, 9×6 in., paper, $1. This new edition represents a modification and expansion of the Standard originally issued in tentative form in 1946. It includes welding schedules for spot and seam welding of mild and medium-carbon steels, low-alloy steels, stainless steels, nickel, Monel, Inconel, and magnesium alloys. Recommended practices for projection welding cover low-carbon and stainless steels. Flash welding data are provided for low and medium forging strength steels. A section on methods of testing resistance welds is also included.

VERÖFFENTLICHUNGEN ZUR ERFORSCHUNG DER DRUCKSTOSSPROBLEME IN WASSERKRAFTANLAGEN UND ROHRLEITUNGEN. Heft 1. By F. Tölke. Springer-Verlag, Berlin, Göttingen, Heidelberg, 1949. 137 pp., illus., diagrs., charts, tables, 11×8 in., paper, 24 DM. This book is based on work done by the German Water Hammer Committee and contains six articles on the following subjects: The standardization of the general language and symbols pertaining to water hammer; causes of water hammer effects in the pressure pipelines of water works; the failure of the Zasip pipeline; water hammer in single pipes; the quantitative determination of water hammer effects in a power station; and the regulation of long hydraulic pipelines.

WISSENSCHAFTLICHE ABHANDLUNGEN DER DEUTSCHEN MATERIALPRÜFUNGSANSTALTEN, FOLGE II, HEFT 7. Holzschutzmitten Prüfung und Forschung. Springer-Verlag, Berlin, Göttingen, Heidelberg, 1950. 132 pp., illus., diagrs., charts, tables, 11½×8¼ in., paper, 21 DM. This publication contains the results of many years of research on the development of testing procedures and the examination of wood-protection media by the German Materials Testing Laboratory. The nine papers in this issue are on the protection of wood from fungus growths, insecticides, tropical conditions and seawater; the wetability of wood by wood-protecting media; wood protectors; the burning characteristics of protected wood; the effect of protectors on wood fibers; and the mutual effects of cement and wood-protecting materials. A bibliography is included.

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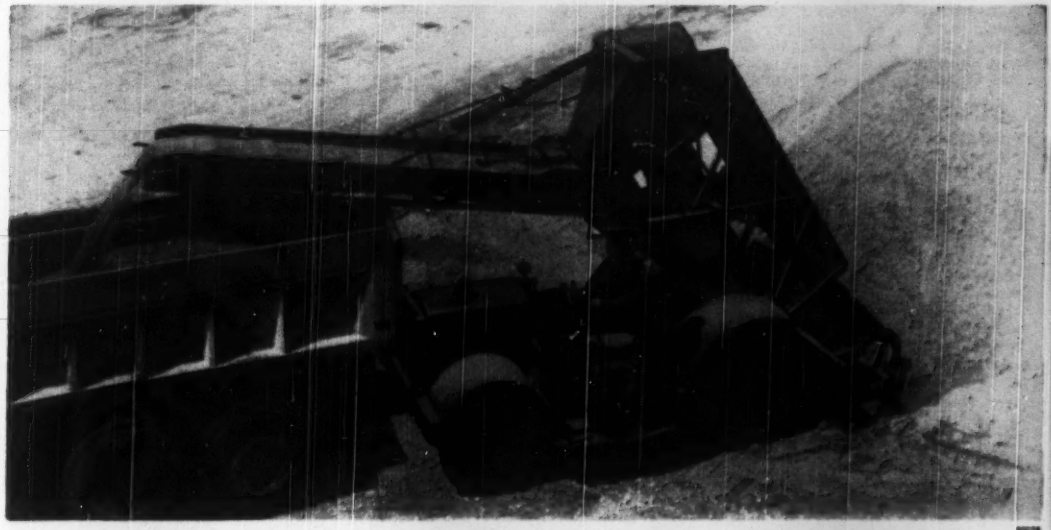
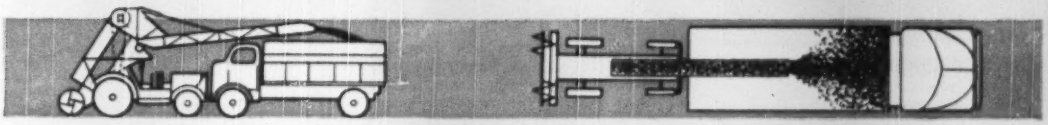


WITH HYDRAULIC LOAD TRIMMER



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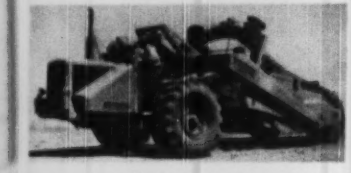
NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Sockets

WIRE-ROPE SOCKETS that reduce dragline rope breakage are now being produced. The socket and its wedge grip rope in true-circle seats. Wide shoulders limit pinching—prevent rope distortion and cutting, and prevent seats from wearing out of round. The rope cannot flatten or crush and rarely breaks. Socket and wedge seats are matched to the size rope for which they are specified. Each socket holds a loop of six complete strands. Gripping pressures are limited by the shoulders so that rope may flex normally without breaking and so that pulling and bending stresses are absorbed evenly over the entire wedge and seating area. One reversible wedge fits all socket types for each size rope. Open and closed end and crowfoot drag sockets come in sizes from $^3/_8$ in. to $2^1/_4$-in. rope. **Baer Steel Products, Inc., Auburn, Wash.**

Scraper

THE NEW MODEL TC-S142 Terra Cobra self-propelled scraper features a more powerful 225-hp engine and larger 24.00 × 25 24-ply low-pressure tires. Substantially increased speed, gradability, traction, flotation and load-carrying capacity are claimed. Other features include formed steel construction for increased ruggedness, 65-in. apron opening and curved ejector designed for faster discharge of sticky materials, increased ground clearance and a number of other improvements.



Model TC-S142

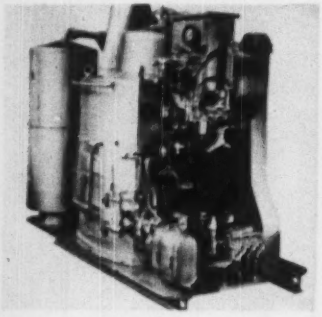
Details and specifications are given in Bulletin TC-706, available upon request to **Wooldridge Manufacturing Co., Sunnyvale, Calif.**

Metal Lath Cutters

OF INTEREST TO builders because of the increasingly popular use of metal laths are the new metal cutters offered by the manufacturer of a complete line of metal cutting tools. These new cutters have center cut jaws with specially pointed noses to allow cutting in narrow spaces. There are no protruding screws or bolts to catch while positioning for a cut. The cutters cut cleanly without distortion of the metal. All types of metal laths—flat-ribbed, reinforced and special patterned up to $^3/_{16}$ in. diameter—may be cut with equal efficiency. **H. K. Porter, Inc., Somerville, Mass.**

Steam Generator

A NEW PORTABLE VAPOR STEAM GENERATOR, Model 4635, for industry supplies large quantities of high pressure steam for short or sustained periods for pile-driving, asphalt plants, chemical processing. This machine develops 200 lb working steam pressure in two minutes from cold water and makes over 3,500 lb of steam an hour, at 75 to 300 lb steam pressure. This is accomplished by hot gases from an efficient forced draft fuel-oil fire wiping over a patented 575-ft steel coil. New features



Model 4635

include: the addition of an economizer coil placed in the path of exhaust gases increases the output and efficiency, relocating the motor to shorten the unit, hotter ignition spark, smaller, heavier mounting plate, larger combustion space, higher working steam pressure of the steam reservoir to 250 psi. Steam is made only when steam is needed. Once started automatic controls take over causing the machine to turn off when the predetermined steam pressure is reached; then on again when the steam pressure drops 15 lb. One 5-hp electric motor or gas engine supplies power to drive the water pump, blower, ignition and fuel pump. The motor mounting plate is designed for easy interchanging of gas to electric motor. Other vapor steam generators available include small ones that develop 300 lb of steam an hour to large units developing over 15,000 lb steam an hour at working steam pressure up to 600 lb. **Vapor Heating Corp., 80 E. Jackson Blvd., Chicago 4, Ill.**

Tagline Control

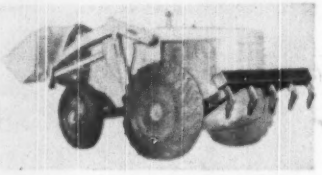
THE "TAG-MASTER" is a control used as an accessory in shovels and cranes to permit a greater degree of efficiency in the operation of this equipment. Its advantage is that loading and casting on draglines is permitted without moving the boom. A 4-page 2-color illustrated booklet is available from **Morin Mfg. Co., Inc., West Springfield, Mass.**

"Hidensity" Welding

A NEW WELDING PROCESS employs welding current densities on $^6/_{32}$-in. electrode wire which melt the electrode at speeds comparable to using 10,000 amp on a standard $^6/_{16}$-in. diameter coated hand electrode. The "Hidensity" process can be used with any standard Lincoln Electric SAE 600 or SAE 900 welding generator or an SAE 600 gasoline engine-driven generator. It uses either a $^3/_{32}$-in. or a $^5/_{64}$-in. diameter electrode wire. Welding currents up to 600 amp are used. These high densities create a deeply penetrating arc which in turn allows the use of high welding speeds. The ML-2 unit consists of a control case, wire reel case, conductor cable and welding gun. The feed mechanism automatically feeds wire at a preset arc voltage from the reel through the conductor cable to the welding gun. With the unit connected, a welding generator can be used for either "Hidensity" hidden arc welding or regular open arc hand welding, but not at the same time. **The Lincoln Electric Co., Cleveland 1, Ohio.**

Hydraulic Scarifier

A HYDRAULIC SCARIFIER for use on Hough payloaders has been introduced. The package unit consists of a scarifier, rams, control valve and all fittings, and utilizes the existing hydraulic system on the payloader. With it the payloader



For use on Payloader

operator has a complete, self-contained piece of equipment. Full utilization of bucket capacity is assured as the operator can scarify his own material, assuring maximum loading. Ripper bar, which clears payloader hitch when raised, has five adjustable shanks with H & L removable teeth. Specifications include: Ripping width, center to center of outside teeth, 70 in.; penetration, 8 in.; raised height, 21 in.; teeth spacing, $17^1/_2$ in.; teeth shanks $1^1/_2$×3 in. ×18 in. Weight, complete unit, 1100 lb. Present production of the Kay-Brunner Scarifier is for the $^3/_4$-yd. Model HF payloader. Specifications and prices may be had by writing **Kay-Brunner Steel Products, Inc., Equipment Div., 2721 Elm St., Los Angeles 65, Calif.**

Equipment, Materials & Methods (Continued)

Theodolite

THE 3.6-IN. THEODOLITE represents the best solution for all practical requirements and is specially designed for surface and mining poligonisations, topographical tacheometry and general surveying. It combines high accuracy with simple handling and fulfils all requirements that may be expected of an instrument of this class. Features include a solid all-covered and closed-in construction which protects all sensitive parts from dust, water and damages. It has a 3-screw-leveling arrangement with provision for regulating tightness and taking up wear, with dust covers, and a quick setting and centering arrangement. An optical plumb is an incorporated feature of the normal equipment, and the instrument is fitted in a metal case including usual small accessories such as adjusting pin, screw driver, oil, plumb bob and instruction booklet. The stand (tripod) is special Fennel type with patent-applied-for holding of the instrument. Additional accessories are available. **Norbert Dienstfrey, 478 Water St., New York 2, N.Y.**

Gearshift Drive

A 5-HP, 1,200-RPM selective speed Lima gearshift drive, Type R3AC, incorporates both primary and secondary gear reductions and is designed to individually motorize and drive machinery of various types that require a low range of selective operating speeds, combined with high radial load capacity. The R3AC is a compact combination of a 5-hp, 1,200-rpm integrally mounted electric motor and a four-speed sliding gear transmission, having selective primary gear ratios. Over-all dimensions, including standard 5-in. output shaft extension are $31^{11}/_{16}$ in. in length, $12^{1}/_{4}$ in. in height and $18^{1}/_{4}$ in. in width, including gearshift lever. The drives deliver full-rated horsepower in each of the four speeds and both constant-torque and constant-horsepower two-speed motors are available on these units, giving the increased flexibility of additional speeds. Other Lima drives are available in ratings of $^{1}/_{2}$ through 25 hp. For literature and additional information write, **The Lima Electric Motor Co., Dept. AC 38, Lima, Ohio.**

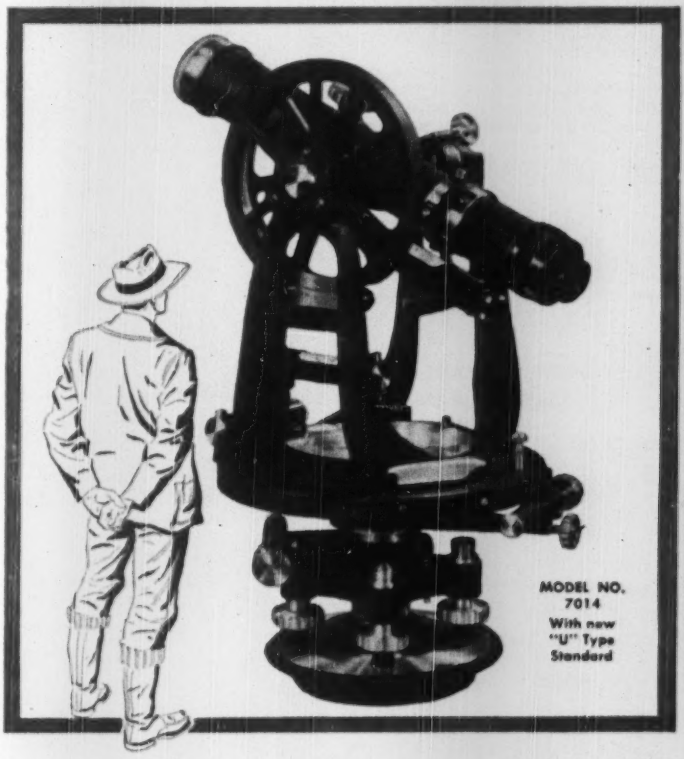
Self-Priming Pump

AN UNUSUAL LINE OF self-priming centrifugal pumps, give unique advantages in self-priming applications—for example, all valves are eliminated by the new design. Other features are: positive self-priming, no large and bulky priming reservoir, no recirculation of water during pumping stage, and efficiencies comparable to standard centrifugal pumps. Made in sizes from $^{1}/_{4}$ hp to 5 hp, open and closed impellers. Capacities to 120 gpm and heads to 135 ft, depending on capacity. Suction lifts up to 25 ft. For more information write for Bulletin 636.1. **Goulds Pumps, Inc., Seneca Falls, N.Y.**

Have you seen the important

NEW FEATURES

on the WHITE Engineers' transit



YES, the White Engineers' Transit is a fine engineer's instrument — now made even finer with the addition of *covered leveling screws* and *coated optics*.

Covered leveling screws assure you of smooth, easy, precise leveling at all times, under all kinds of conditions for the life of the instrument itself.

Coated optics guarantee clear, sharp, accurate images — without halation, at longer distances, even under adverse conditions.

Compare the David White Engineers' Transit with all others—feature for feature — price for price. Compare them for accuracy — long durability — built-in quality. To meet your preference, this instrument is available with "U" or "A" type standards. You'll find you'll buy right when you buy a David White.

Contact our nearest dealer for complete details of the David White Engineers' Transit and for other fine Engineering Instruments—or write direct to David White, 359 W. Court St., Milwaukee, Wis.

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We offer complete, prompt repair service on all makes of instruments — levels, transits, theodolites, etc.

Going down to stay!

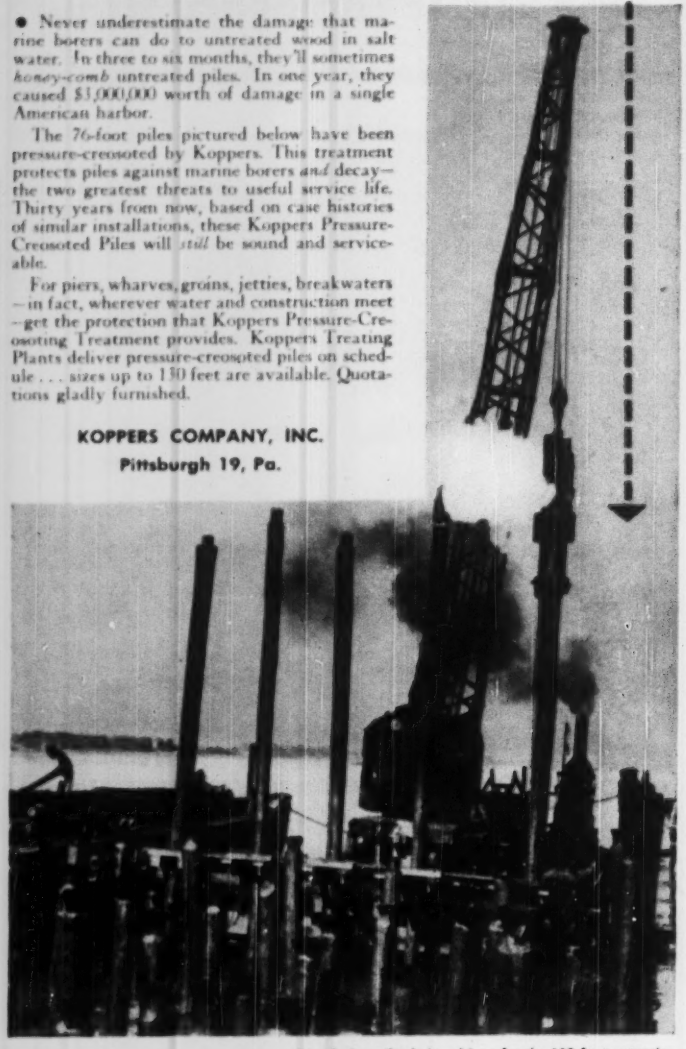
THEY'RE KOPPERS PRESSURE-CREOSOTED PILES

● Never underestimate the damage that marine borers can do to untreated wood in salt water. In three to six months, they'll sometimes *honey-comb* untreated piles. In one year, they caused $3,000,000 worth of damage in a single American harbor.

The 76-foot piles pictured below have been pressure-creosoted by Koppers. This treatment protects piles against marine borers *and* decay—the two greatest threats to useful service life. Thirty years from now, based on case histories of similar installations, these Koppers Pressure-Creosoted Piles will *still* be sound and serviceable.

For piers, wharves, groins, jetties, breakwaters—in fact, wherever water and construction meet—get the protection that Koppers Pressure-Creosoting Treatment provides. Koppers Treating Plants deliver pressure-creosoted piles on schedule . . . sizes up to 130 feet are available. Quotations gladly furnished.

KOPPERS COMPANY, INC.
Pittsburgh 19, Pa.



Foundation piles being driven for the 150-foot extension of the U. S. Coast Guard pier at Charleston, S. C.

KOPPERS PRESSURE-TREATED WOOD

Equipment, Materials & Methods (Continued)

Sewage Handling Pump

A NEW LINE OF PUMPS (Type SW) designed especially for sewage handling has been announced. The line follows the design of Allis-Chalmer's solids-handling pump, but has a special sewage type impeller with well-rounded inlet edges and large fillets to minimize clogging. On the larger size pumps, a Francis type vane with rounded inlets is used for high efficiency. This vane is also used on smaller pumps in the line where maximum sphere size is of secondary importance, such as sewage sludge service. The pump can be used either horizontally or vertically with numerous suction and discharge nozzle arrangements. It is designed so that the entire rotating element can be removed readily without breaking pipe connections or moving the prime mover should it be necessary to dismantle the rotor. Vertical style pumps are mounted on a rigid supporting base and a suction elbow with clean-out cover is provided. Intermediate shafting includes a universal joint coupling fitted to the pump and motor shafts with a Magic-Grip bushing. The pumps cover a range of from 175 gpm to 10,000 gpm with heads up to 150 ft. They are available in an all iron or bronze fitted construction. **Allis-Chalmers Mfg. Co., Milwaukee, Wis.**

Dragline Chain

A SUPER-STRENGTH CHAIN for power shovel and dragline use is now being produced. It is cast of Baer's Fibraloy steel which was originally developed to absorb the battering required of earth-moving bucket castings. At 150,000 lb per sq in. tensile, it is the strongest chain made for the purpose. Extra strength allows longer wear within the working capacity of the chain and permits the use of 10% lighter lengths when new. Extra toughness at high hardness levels provides the chain with superior shock resistance, especially at sub-zero temperatures, and with high abrasion resistance. Since Fibraloy resists plastic deformation, the metal does not thin out when overloaded. Full-bodied links, seating on large bearing surfaces, guarantee the whole chain an extra long, trouble-free wear life. **Baer Steel Products, Inc., Auburn, Wash.**

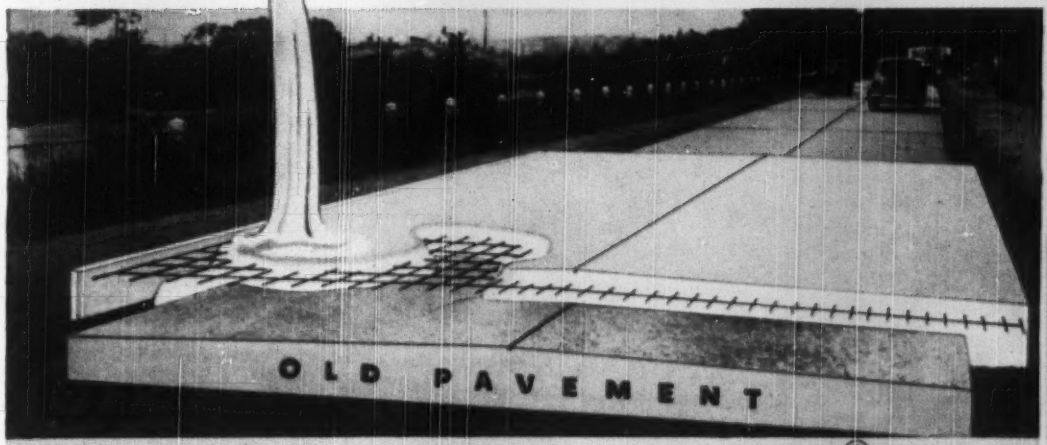
Sludge Control Valve

A TELESCOPING SLUDGE CONTROL VALVE recently designed provides positive, visible control of the quality and quantity of sludge withdrawn from the hoppers of a settling tank—without breaking through the sludge blanket and drawing liquid of low solids content. Sludge is forced by hydrostatic pressure from the tank sludge hopper through an adjustable slip pipe of the sludge valve into a sludge well, from which it is pumped into the digester or returned to the process. The valve is

(Continued on page 100)

Build New Life into old roads

with American Welded Wire Fabric



The large composite picture shows how existing roads can be widened and strengthened by resurfacing with concrete, reinforced from shoulder to shoulder with American Welded Wire Fabric. The small sketches show how Welded Wire Fabric prevents progressive damage by holding cracks tightly closed.

When your old roads prove unable to handle the increased weight and volume of today's traffic, you often can restore them to full service without incurring the excessive cost of replacing the entire road. Many highway engineers have modernized their old roads by surfacing them with concrete reinforced with American Welded Wire Fabric.

Using the old pavement as a foundation, they have built wider roadways to accommodate a greater number of vehicles. The reinforced concrete slabs are stronger — readily withstand the incessant pounding of heavy loads. A new reinforced concrete surface provides better visibility and insures greater safety than other types of resurfacing.

In resurfaced concrete roadways, the many small, closely spaced steel members of American Welded Wire Fabric fortify all parts of the slab against stresses and strains in all directions. The rate of cracking is sharply reduced and such cracks as do occur are held tightly closed, preventing progressive damage to the pavement.

When you are planning to build new life into old roads, our technical staff will be glad to supply complete data on specific designs and standard styles of U·S·S American Welded Wire Fabric that are available. Write to our nearest sales office today, you incur no obligation.

AMERICAN STEEL & WIRE COMPANY
GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO
PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL, IRON & RAILROAD COMPANY
BIRMINGHAM, SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Every concrete paving job needs

AMERICAN WELDED WIRE FABRIC

reinforcement

USS

UNITED STATES STEEL

mounted so that the discharge can be readily observed as the sludge is being drawn into the sludge well. Therefore, concentrated sludge—not sewage—is delivered to the digester. Less digester supernatant is produced and returned to the process, eliminating supernatant overloading. The valves are standardized in 4 in., 6 in. and 8 in. sizes, but 10 and 12 in. sizes can be supplied. Although primarily used as sludge valves, the valves also may be used to adjust rate and quality of return activated sludge or settled tank contents for recirculation to other points in the process. For information write to **The American Well Works, Aurora, Ill.**

Asphalt Road Planer

THE ASPHALT ROAD PLANER Model 31 which is powered by an International gasoline engine with electric starter, generator, battery, oil bathair cleaner, heat indicator, and oil pressure gage has been announced. The machine has been designed to materially improve the resurfacing and renovation of old asphalt road pavements. One Clarkmoore fuel oil burner is used to supply intense heat to the heating hood area. This burner throws a flat or horizontal flame into the heating hood, thus eliminating the "blow torch" effect that is detrimental to asphalt. Fuel oil is forced into the burner under pressure and properly mixed with air. The heat from the one burner is deflected by the hood's surface to the asphalt pavement. The even intense heat makes possible the planing action of the two section planing blades which cut and remove the rough and corrugated asphalt pavement to any desired depth without tearing or gouging, thus leaving a table-smooth surface ready for seal coating. The depth of the cut is controlled hydraulically. Approximately 6 gal. of fuel oil are required per hr. The frame is made of heavy structural members, fully boxed and all electrically welded construction. **Asphalt Maintenance Co., 41 Park Row, New York 7, N.Y.**

Easy to lay MECHANICAL JOINT

M & H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA

The wide use of Standardized Mechanical Joint Cast Iron Pipe for water supply systems has created an urgent demand for Mechanical Joint Valves, Hydrants and Accessories. M & H has been a leader in recognizing this important trend and can supply AWWA Gate Valves with Mechanical Joint ends, in sizes 2" to 30" inclusive . . . Mechanical Joint Cutting-In Sleeves . . . . and Mechanical Joint Hydrants in all sizes and all types.

M & H Mechanical Joint features are: Ease and speed of installation, construction economy, joint deflection, leak-tight, long life. Used with AWWA, Classes A.B.C.D.; Federal Specification WW-P-421; or Classes 100, 150, 200, 250 Centrifugal Pipe.

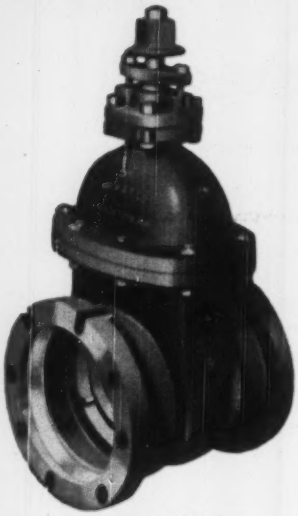


Fig. No. 67 M

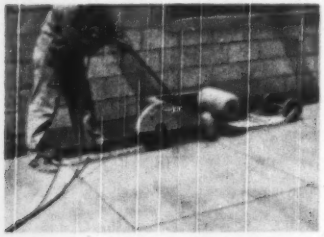
WRITE FOR CIRCULAR No. 49

Our New Circular No. 49 shows important installation dimensions of M & H AWWA Mechanical Joint Hydrants and Valves . . . . Underwriters and Associated Factory Mutual approved Post Indicator Valves . . . and Cutting-In-Sleeves.

M & H Products • Everywhere

Concrete Saw

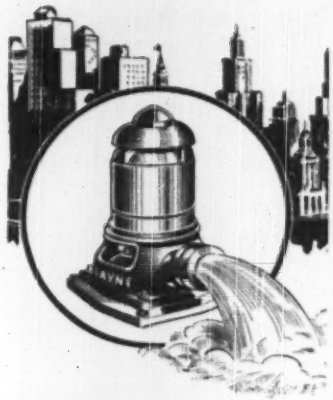
THE "CREEPER" is a newly designed concrete saw. Contractors can quickly trim precast slabs to special size or shape right on the job. The saw will do the job cheaper and better in all other instances where hand chiseling or hand saw cutting or marking needs to be done in asphalt or concrete according to the manufacturer. The concrete saw features an electric motor, guide rails and a choice of either wet or dry cutting. The electric



The Creeper

motor assures a smooth constant flow of power, the guide rails guarantee a straight clean cut and eliminate cutting blade breakage. For dry cutting inexpensive abrasive blades can be provided. Specially bonded, abrasive or diamond blades are likewise available from the manufacturer for wet cutting. All working parts are shielded by extra heavy gage sheet steel welded into a single unit. The cutting assembly is pivoted on ball bearings and glides over angle iron rails. So balanced that all weight rests forward on semi-pneumatic tires the saw can easily be rolled to the job. Prices on request from **Martin Fireproofing Corp., P.O. Box 27, Kenmore Station, Buffalo 17, N.Y.**

When Writing Manufacturers for Information Please Mention Civil Engineering



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In all the world, there is no firm that equals Layne in skill; none that has had so much experience and none that is known to be so successful. Layne has built many successful systems where others have failed, proving that skill was the needed factor.

Layne constructs perhaps more big Well Water Systems than any other firm in the Nation. In addition to skill, Layne can offer the finest types of equipment, some of which they build for their exclusive use.

LAYNE & BOWLER, INC.
General Offices, Memphis 8, Tenn.

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WELL WATER SYSTEMS
VERTICAL TURBINE PUMPS

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Equipment, Materials & Methods (Continued)

Pumps

A LINE OF ELECTRIC SUBMERSIBLE PUMPS has been designed for both domestic and industrial water supply systems and range in size from 0.7 to 60 hp with capacities from 5 to 1250 gal per minute. The pump and motor are assembled as a unit designed to operate in the well completely submerged in water. Installation is effected simply by lowering the pump on its riser pipe to the proper depth and connecting a submarine power cable to a convenient source of electric power supply. The pumps combine a number of unique features. The multi-stage centrifugal pump is of bronze and stainless-steel construction throughout. The motor, which is especially built for underwater operation, is of the dry-starter type with the rotor running in and cooled by water. Bulletin No. 100 has full information. A copy can be obtained from **Sumo Pumps, Inc., 1 Atlantic St., Stamford, Conn.**

Water Level Indicator

A SMALL, COMPACT AND easily portable water level indicator, to determine accurately the depth to water in a well or drill hole, has been developed. By means of this device, engineers, geologists and well drillers can obtain accurate information regarding the water table under static, pumping or seasonal conditions. The cable, batteries and operating components of the Model WL equipment are all included in one compact spool-type unit, which operates on two 45-volt dry cell batteries. As an added feature, the spool is designed to be used as a convenient reel for taking in and letting out the cable. It is equipped with 250 ft of cable; however, any additional amount required can be provided. Additional information will be furnished by **Fisher Research Laboratory, Inc., 1961 University Ave., Palo Alto, Calif.**

"Pressureflo" Control

A NEW DEVICE FOR automatically controlling pump operation has been announced. The "Pressureflo" control consists of a flow-determining means, a pressure or level sensing device and a mechanism to translate this "information" into a control function. Metering devices are normally desirable on any system. Other equipment consists of standard components plus a special control device to convert flow and pressure into pump response. The control may be used to start and stop pumps, to increase or decrease the speed of one or more pumps, to maintain a predetermined pressure at any point or district on a distribution system, or to automatically adjust both pressure and flow to suit varying demands. These are but a few of the many possible applications in

(*Continued on page 102*)

SAVINGS
FLOW FROM
SPEED-LAY
PIPE SYSTEM
EVERYTHING for a COMPLETE PORTABLE PIPE SYSTEM

- FACTORY PACKAGED
- PIPE COUPLINGS
- FITTINGS
- VALVES
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Immediate Installation
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Please send free booklet describing your Speed-Lay Pipe System and services.

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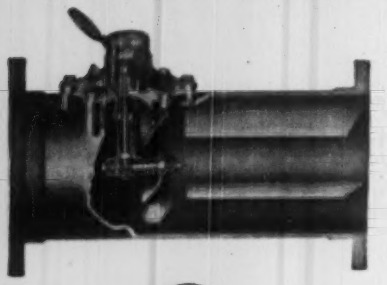
SPARLING MAIN-LINE METERS



There is no simpler way to measure liquid flows than to mount a propeller in the pipe. The flow turns the propeller and this, through ball bearings and gears, advances the Totalizer.

Accurate? Each meter is individually tested and is guaranteed for accuracy within 2 per cent throughout the meter's rated range.

Over thirty years' experience goes into the making of the Sparling Meter you install!

TOTALIZERS INDICATORS
24-Hour, 7-Day, 60-Day RECORDERS
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Equipment, Materials & Methods (Continued)

the pumping of water, sewage, oil or gas or the transmission of other liquids. Savings resulting from its use include reduced power costs by more efficient operation of pumps, reduced maintenance on pumps, elimination of need for station attendants, reduced costs of installation and operation of elevated storage tanks, indirect increasing of distribution system capacity, full available capacity instantaneously for fire demands and other plus values. The pressure-flow system of control may be adapted to any distribution system. For additional information, write **Builders-Providence, Inc., 345 Harris Ave., Providence 1, R.I.**

Scaffolding

A STEEL SCAFFOLDING for light-duty construction and maintenance is announced. The product is known as the Safway "4 by 4" steel scaffolding because the basic end frame members measure 4 ft wide by 4 ft high. These parts may be assembled in scaffolds or towers as high as 40 ft, and for loads not exceeding 50 lb per sq ft. Because of its modest cost, this modern steel scaffolding is expected to replace wood trestles or horses and wood pole-and-crossbar scaffolding for many light-duty applications. Four by four members are made from high-carbon steel tubing of ample wall thickness and diameter, solidly welded in a sturdy, rigid design. The standard end frames are certified to 4,000-lb uniform load and 16,000-lb total leg load. In use, this portable scaffolding may be rapidly assembled or dismantled by unskilled help, without special tools. The scaffolding members are stored compactly, and can be re-used indefinitely in any other combination. Working platforms can be located at 16-in. intervals. Work materials are always ready at waist level on a convenient material rack. **Safway Steel Products, Inc., 6234 W. State St., Milwaukee 13, Wis.**

Pump-Turbine Unit

A RECENTLY DESIGNED PUMP-TURBINE unit stimulated a revival of interest in the old idea of pumped storage hydroelectric power. The combination unit, for off-peak pumping from a low-level to a high-level water reservoir and peak period power generation with reverse flow, would make this tempting method of storing water power economically feasible for the first time. Elimination of the need for additional pumping equipment is the major advantage. The pump-turbine is a single runner enclosed in a casing with a stay ring and movable wicket gates. Rotated in one direction it is a centrifugal pump; reversed, it functions as a hydraulic turbine through which water returns from the storage reservoir to generate

(Continued on page 103)

Imperial

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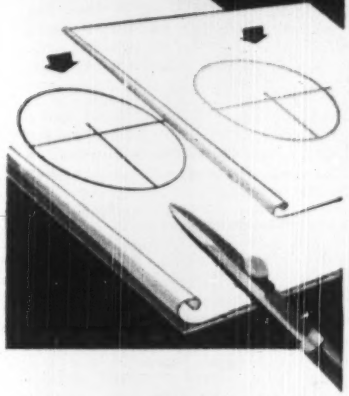
THAT DEFIES TIME!



• The renown of Imperial as the finest in Tracing Cloth goes back well over half a century. Draftsmen all over the world prefer it for the uniformity of its high transparency and ink-taking surface and the superb quality of its cloth foundation.

Imperial takes erasures readily, without damage. It gives sharp contrasting prints of even the finest lines. Drawings made on Imperial over fifty years ago are still as good as ever, neither brittle nor opaque.

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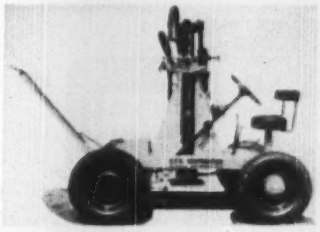
Equipment, Materials & Methods (Continued)

power at period of greatest demand. Pumped storage hydroelectric plants will require electrical equipment of the same general nature as is now used in generating stations or pumping plants. The information required in specifications for a pumped storage plant would include the following: elevation of suction pool with pool filled, approximate drawdown of pool in feet during pumping cycle, elevation of storage reservoir with water at lowest level (at beginning of pumping cycle), elevation of storage reservoir with water at highest level (at end of pumping cycle), size and length of penstock to be used from storage reservoir to pump turbine, estimated friction loss in the system, and output per unit in kilowatts desired over the average generating period of 8 hours. The manufacturer would determine the size of unit required, specify the rpm, and furnish expected performance curves for generating and pumping with the head range indicated by pool elevations. For more detailed information write **Allis-Chalmers Mfg., Co. Milwaukee, Wis.**

Pavement Breaker

ONE OF THE BIGGEST FEATURES of the B Model pavement breaker is that it is automatically controlled, which practically eliminates all of the upsurge of the piston against the top head and 95 percent of the over-reach on the bottom head. This



Model B

machine was designed after two years experience with the one-wheel drive Mighty Midget and has several improvements over the original machine. It is equipped with a 200-lb head which gives a more effective blow, and with a conventional automobile rear end, driving on both wheels, which makes it a simple matter to keep this machine on the line while in action. It is equipped with an automatic attachment with the auxiliary cylinder standing parallel with the main cylinder. This cylinder is actuated with the guide rod with a piston on one end. On the Model B, as the hammer is put into motion, this auxiliary cylinder pumps air to the piston that actuates the valve and by using all of the air or a lesser amount you can effect a longer or shorter stroke as desired, by letting the desired amount of air in needed to discharge by opening a bypass. New type tools are interchangeable with either the old machine or new ones. **R.P.B. Corporation, 2751 E. 11th St., Los Angeles 23, Calif.**

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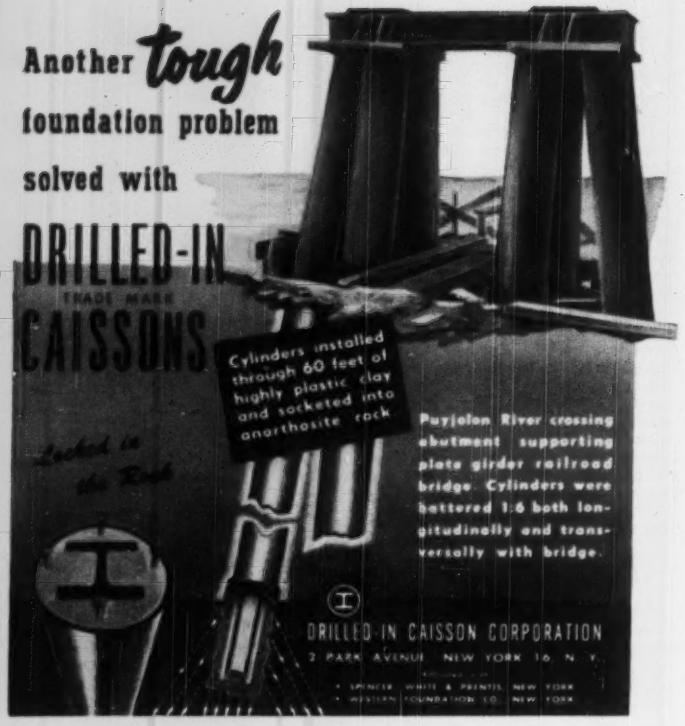
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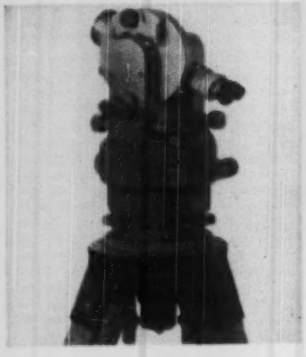

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(Continued on page 106)

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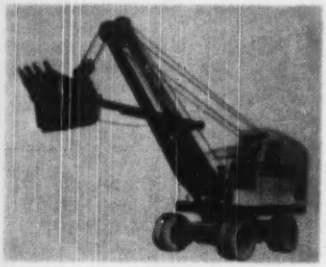
Equipment, Materials & Methods (Continued)

Shovel

THE HEAVY-DUTY MODEL 20 is particularly designed for the contractor who wants the economical operation of a $^1/_2$-yd machine and big machine yardage. The $^1/_2$-yd shovel crane has a 10-ton lifting capacity with extended outriggers and auxiliary counterweight. The working weight of 30,360 lb as a shovel seems to indicate extra-sturdy construction for a $^1/_2$-yd machine. The Model 20 is easily convertible to all front-end attachments.



Model 20

It travels, lifts, booms and swings simultaneously or independently. Four-point "walking" beam suspension provides equal stability while lifting or digging even on rough terrain. Full 360° operation, 7-ft 8-in. wheelbase and short turning radius facilitate operations in tight spots. Mounted on four sets of dual pneumatic tires, the Model 20 travels at speeds up to 15 mph. The upper works of the machine are enclosed in a weatherproof, inside bolted cab of a design which permits inside access to all deck machinery. Other features include unit replacement of all subassemblies, a built-in counterweight to shorten rear end clearance of cab, 15-in. dia drums for increased life of the wire rope, and prominent use of anti-friction bearings. Standard power unit for the Model 20 is a 62 hp, six-cylinder gasoline engine. **Wayne Crane Div., American Steel Dredge Co., Inc., Fort Wayne, Ind.**

Copperheating

A HOT-WATER HEATING SYSTEM for homes and other buildings has been successfully introduced in Detroit. A circulating pump is attached to the gas- or oil-fired boiler. When thermostat is turned up, hot water is pushed at 10-ft-per-second speed through $^3/_4$ in. copper tubing. New-type radiators in each room, called Wallrads, have individual small blowers with both thermostatic and manual control. Heat is pushed out rapidly across the floors. This system, known as "Copperheating," is claimed to give heat faster from a cold start than any other system; also, to deliver hot water heat for only slightly more than the cost of warm air. For information, write **Copper Heat Industries, Inc., Detroit 21, Mich.**

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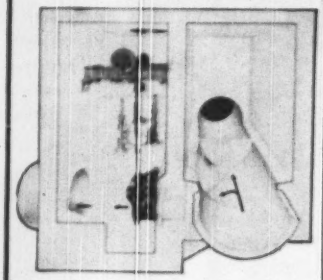

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

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Literature Available

PUMPS—A bulletin W-300-B1 describing Monobloc centrifugal pumps, types DN, DNE, DDN, DDNE and DNH, single and two stage, size 1 to 5, is announced. The bulletin includes specifications, motor data and materials for construction. Eleven pages are devoted to a section entitled, "How to Select a Cold Water Pump." **Worthington Pump & Machinery Corp., Harrison, N.J.**

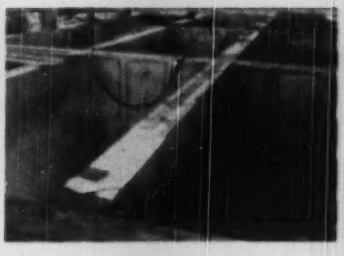
TRENCHLINER—An attractive 12-page catalog, printed in two colors, describing the Parsons Model 310 trenchliner and illustrating its extra large work capacity features is available for general distribution. More than 50 photographs describe the high capacity production features incorporated. Parsons exclusive, time-tested engineering details are discussed in detail. Copies may be obtained by writing to the **Parsons Co., Newton, Iowa.**

POWER SHOVELS AND CRANES—A catalog on the Lorain-50 series of power shovels and cranes has just been published. This is the first machine in the 1 yd class equipped with a hydraulic coupling as standard equipment. This and many other features such as new swing clutches, one-piece cast steel turntable bed, air controls for steering and tread lock are illustrated and described. Four different size crawlers are available in this series as shovel, dragline, clamshell, crane and hoe. **Thew Shovel Co., Lorain, Ohio.**

PLACING CONCRETE—A catalog with the theme "Placing Concrete on Big Jobs" is now offered. Twenty different models ranging in capacity from $\frac{1}{4}$ to 8 cu yd are described listing complete dimensions, specifications and data on the Gar-Bro line of concrete buckets. Illustrated and described are the double clamshell gate design, self-closing spring-operated gates, discharge by remote control, center discharge for accurate placing and two attachments, the accordion type collection hopper and the suspended steel subhopper with elephant trunk. **Gar-Bro Manufacturing Co., Los Angeles, Calif.**

WELDED STEEL TUBING—The structural advantages, methods of fabricating and characteristics of Armco welded steel tubing are discussed in a 12-page, illustrated booklet. It outlines the characteristics of tubing—excellent finish, close tolerances, uniform mechanical properties—and shows a variety of uses where tubing has been effectively used to cut manufacturing costs, reduce weight, increase strength and improve appearance. Complete information is included on how hot- and cold-rolled as well as Zincgrip and Aluminized tubing is supplied—size limits, finish, tolerances and properties—and how it should be ordered. Copies can be obtained from **Armco Steel Corp., Middletown, Ohio.**

(Continued on page 108)



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Photos above show units number 1 and 2 of the new 150 m.w. turbogenerator steam electric station of the Pennsylvania Power and Light Company at Sunbury, Pa.

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Above: Section of typical echo depth recording showing depth and bottom contour. Clearly reveals composition: Mud, rock, etc. Precision recorder prices begin at $3300.

Literature Available (Continued)

CRAWLER TRACTOR—A 24-page catalog describing the new International TD-18A crawler tractor is announced. Produced in two colors, this catalog contains pictures, sectional views, and diagrams fully illustrating the features of the tractor. Ask for form number A-154-NN, **International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.**

HYDRAULICS CALCULATOR—The American Concrete Pipe Assoc. has recently completed printing a calculator which is based on Manning's formula. It is entitled "Field's Hydraulics Calculator," and there are a limited number of copies available, at a cost of $3.00 each, at **The American Concrete pipe Assoc., 228 N. LaSalle St., Chicago.**

DIESEL TRACTOR—A 29-page illustrated booklet entitled, " 'Caterpillar' D8 Diesel Tractor," has been released. Featured in the booklet is the D8's ability to get things done effectively, efficiently, and with a minimum of "time-out" for maintenance and repair. Quality features of this diesel track-type tractor are discussed and illustrated along with complete specifications. Ask for Form 12676. **Caterpillar Tractor Co., Peoria 8, Ill.**

SAND-DRAIN METHOD—A folder describing a simple and economical method for quickly stabilizing soft marshy ground on which a road, airport or earth dam is to be built is now offered. This procedure is fully described, together with an explanation of the equipment used. Among the illustrations are diagrams showing the action of the Sand-Drain method and many photographs of the rigs in operation. Copies of the folder can be obtained by addressing **Dept. 3, McKiernan-Terry Corp., 15 Park Row, New York 7, N.Y.**

MACHINERY DIVISION—A brochure illustrating McKiernan-Terry Corp. production facilities for the manufacture of a wide range of complete special machinery, subassemblies and precision parts was recently published. Some of the Company's mills, lathes, radial drills, grinders, planers millers and equipment for work of all types and sizes are shown. The bulletin explains how this equipment has been used in manufacturing special machinery for many industries. Copies can be obtained by addressing **McKiernan-Terry Corp., Dept. 26, Special Machinery Div., 15 Park Row, New York 7, N.Y**

COMBINATION UNITS—The design and engineering of two unique combination units in modernizing the Montreal refinery of the British American Oil Company, Ltd., are featured in Kelloggram No. 3 (1950), just published. The publication covers the combination deasphalting and crude topping and the combination fluid catalytic cracking and catalytic polymerization units in detail, and also shows how, through painstaking process design, heating requirements were balanced so that important savings were effected in furnaces and intermediate storage. **M. W. Kellogg Co., Jersey City, N.J.**

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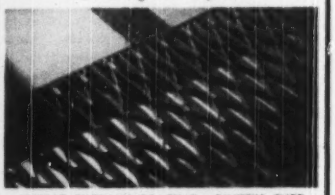
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Closed to Further Discussion

1. **Improvements at the Back River Sewage Works, Baltimore, Md.**, by C. E. Keefer, M. ASCE.

2. **Public Utility Condemnation Cases in the State of Washington** by Henry L. Gray, M. ASCE.

3. **Treatment of Foundations of Large Dams by Grouting Methods** by A. W. Simonds, M. ASCE, Fred H. Lippold, M. ASCE, and R. E. Keim, Assoc. M. ASCE.

4. **Capillary Phenomena in Cohesionless Soils** by T. William Lambe, Jun. M. ASCE.

5. **Elastic Restraint Equations for Semi-Rigid Connections** by J. E. Lothers, M. ASCE.

6. **Slope Deflection Equations for Curved Members** by Keith T. Fowler, Jun. M. ASCE.

7. **The Geochemistry of Earthwork** by Hyde Forbes, M. ASCE.

8. **Floating Tunnel for Long Water Crossings** by Charles E. Andrew, M. ASCE.

9. **Atchafalaya River Diversion and Its Effect on the Mississippi River** by Leo M. Odom, M. ASCE.

10. **Pollution Abatement Policy** by Thomas R. Camp, M. ASCE.

11. **Long-Term Storage Capacity of Reservoirs** by H. E. Hurst.

12. **Influence Charts for Concrete Pavements** by Gerald Pickett and Gordon K. Ray, Jun. M. ASCE.

13. **Reinforced Concrete Skewed Rigid-Frame and Arch Bridges** by Maurice Barron, M. ASCE.

14. **Mathematical Analysis of an Aerial Survey** by Lo-Ho.

15. **Computation of Equitable Charges for Treatment of Municipal Sewage** by Ellis E. Bankson, M. ASCE.

D-VII. Discussion of Paper, **Deflection of Plywood Beams Due to Moisture Content Change**, by W. E. Wilson and Laurence G. Olson.

Summarized in Earlier Issues

16. **Pavement Bearing Capacity Computed by Theory of Layered Systems** by Guthlac Wilson, M. ASCE, and G. M. J. Williams, Jun. M. ASCE.

17. **Origin and Significance of Openwork Gravel** by Allen S. Cary, Assoc. M. ASCE.

18. **Successive Approximations for Beams on an Elastic Foundation** by E. P. Popov, Assoc. M. ASCE.

19. **Flood-Control Operation of Tennessee Valley Authority Reservoirs** by Edward J. Rutter, M. ASCE.

20. **Three-Dimensional Displacement Diagrams for Space Frame Structures** by Walter Worthington Ewell, Jun. M. ASCE.

21. **Maximum Load Capacity of Bailey Bridges** by Robert B. Stegmaier, Jr., Jun. M. ASCE.

22. **Specifications for Heavy Duty Structures of High-Strength Aluminum Alloy**, Progress Report of the Committee of the ASCE Structural Division on Design in Lightweight Structural Alloys.

23. **Influence of Heavy Loads on Pavement Design Trends** by K. B. Woods, M. ASCE.

24. **Summary of Buckling of Rigid-Jointed Plane Trusses** by N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman.

25. **Uplift Pressures in Concrete Dams** by Kenneth B. Keener, M. ASCE.

D-XVI. Discussion of Paper, **Stream Flow Variability**, by E. W. Lane and Kai Lei. Discussers are: Ven Te Chow, Dana M. Wood, H. Alden Foster, C. S. Ospina and G. Tama, Raphael G. Kazmann, Jack Bruin and H. E. Hudson, Jr., H. W. Lull, William D. Mitchell, C. R. Ownbey, S. P. Wing, J. E. McKee, and G. B. Schroyer and E. T. Schuleen.

D-XVII. Discussion of Paper, **End Restraints on Truss Members**, by Harold E. Wessman and Thomas C. Kavanagh. Critical and constructive comment was received from Jack R. Benjamin, George Winter, Abraham Slavin, J. Edmund Fitzgerald, Joseph S. Newell, and Charles W. Dohn. The authors' closure should be read with interest by everyone concerned with the practice and theory of structures.

D-XVIII. Discussion of Paper, **Frequency Analysis of Beam and Girder Floors**, by Hans H. Bleich. A brief discussion by Robert V. Hauer, with an answering comment from Mr. Bleich, constitutes the total scope of this Separate.

D-XIX. Discussion of Paper, **Roads and Pavements, Sampson Naval Training Station**, by Jacob Feld. Valuable discussion is presented by P. F. Phelan, which calls for a brief closing comment by the author.

D-XX. Discussion of Paper, **Aerodynamic Theory of Bridge Oscillations**, by D. B. Steinman. Discussers are: David J. Peery, Alexander Klemin, Abraham Slavin, Charles W. Dohn, Boris A. Bakhmeteff, F. J. Maher and J. B. Eades, Edmund Pinney, Harold A. Thomas, Elmo G. Peterson, William Allan, Paul Lieber, S. K. Ghaswala, Peter L. Tea, Edward Adams Richardson, H. H. Bleich, F. B. Farquharson, and George S. Vincent. The author's reply is comprehensive and thorough.

26. **Industrial Stream Pollution Abatement**, by L. L. Hedgepeth.

27. **Plasticity of Metals—Mathematical Theory and Structural Applications**, by D. C. Drucker, Assoc. M. ASCE.

28. **Retrogression on the Colorado River Since 1935**, by J. W. Stanley.

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Second Notice

31. **Measurement and Analysis of Suspended Sediment Loads in Streams**, by Martin E. Nelson and Paul C. Benedict. Federal agencies concerned with development of river

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resources for flood control, irrigation, soil conservation, water power, navigation, and water supply are making a concerted effort to standardize methods and equipment for measurement and analysis of sediment loads in streams. The paper describes such aspects of the fluvial sediment problem as the history of sediment investigations, the theory of the sediment transportation phenomenon, methods and equipment used in sampling sediment, and the development of improved samplers and laboratory equipment for analyzing sediment samples. (Available October 1.)

32. Effect of Skew Angle on Rigid-Frame Reactions, by Walter C. Boyer. The skewed rigid-frame bridge is recognized as a grade-separation structure which conforms ideally to essential road alinement. Methods of analysis are now available which reduce the arduous labor of design once attributed to this structure. In spite of rather general acceptance of present design procedure, doubts are occasionally expressed concerning its validity. This paper describes the test procedure and results obtained from a model study of the rigid-frame bridge and traces the variation of reactive elements for skew angles of from 0° to 50°. (Available October 1.)

33. Strength of I-Beams in Combined Bending and Torsion, by Basil Sourochnikoff. I-beams in combined bending and torsion are often encountered in practice, particularly in structures supporting complex industrial equipment where it is sometimes impossible to avoid eccentric loads on beams. In this paper, stresses in beams due to the interaction of bending and torsion and the influence of the deflections on stresses are analyzed, allowable stress formulas are established, and a comparison with existing design methods is given. (Available October 1.)

34. Lateral Buckling of Eccentrically Loaded I-Section Columns, by H. N. Hill and J. W. Clark. In designing a member for simultaneous axial compression and transverse bending, it is necessary to reduce the allowable end load and the allowable bending moment below the values which would be permitted if either occurred alone. Failure of such a member may result from excessive bending in the plane of the applied bending moment or from lateral buckling. The latter type of failure is the subject of this paper, which reports the results of tests on I-section columns loaded eccentrically. (Available October 1.)

35. Design Curves for Footings on Soil, by Winfield A. McCracken. The curves cover footings of uniform thickness and sloped, or stepped, footings over a wider range of design conditions than the most comprehensive tables. They can be used with little more effort than a comprehensive table and with the confidence acquired by going through the design procedure rather than with blind acceptance of tabular values. (Available October 1.)

D-XXII. Discussion of Paper, **Analytical Method of Determining the Length of Transition Spiral,** by Michael V. Smirnoff. The original paper, published in November 1949 PROCEEDINGS (p. 1283), presented a step-by-step approach to the problem of expressing the length of transition spiral. Discussion by T. F. Hickerson, Thomas R. Klingel, Carl F. Meyer, Joseph Barnett, J. J. Leeming, Allen G. Tyson, Donald Thompson, and Ralph A. Moyer, and the author's closing arguments, will be read with keen interest by specialists in the field. (Available October 1.)

D-XXIV. Discussion of Paper, **Diversion Tunnel and Power Conduit of Nantahala Hydroelectric Development,** by D. J. Bleifuss. The original paper, published in December 1949 PROCEEDINGS (p. 1409), gave, in detail, the salient design considerations of a part of a great hydroelectric project in North Carolina. A thorough discussion by Joseph R. Bowman emphasizes the particular problems of energy dissipators, gate guide alinement, gate-opening devices, the power intake gate hoist, the pipe line, penstock, and surge tank. Each of these topics is taken up in turn in the author's brief closing discussion. (Available October 1.)

First Notice

36. Impossibility of Performance in Contracts for Engineering and Construction, by Robert F. Borg. When will an agreement for a project be excused as impossible of performance? A practicing contracting engineer (who is also a member of the New York State Bar) examines, from an engineer's point of view, a problem that has resulted in many law cases. The established rule forbids excuse for impossibility, but the numerous and various exceptions are grouped and described. The purpose is to enlist the discussion and aid of the engineering profession in assisting the courts to solve this ever difficult problem. (Available November 1.)

37. Design of Prestressed Tanks, by J. M. Crom. The author's experience in supervising the design and construction of more than 500 prestressed circular concrete tanks forms the basis of this analysis of the design principles involved. Substantial losses of stress occur in the prestressing steel as a result of shrinkage and plastic flow in the concrete. With low initial stresses in the prestressing steel, after deducting losses due to shrinkage and plastic flow, the effectiveness of prestressing is largely nullified. This emphasizes the advantages in prestressing with high-strength steel wire having initial design stresses of about 150,000 lb per sq in. (Available November 1.)

38. Hydrology of Mexico, by Andrés García-Quinonero. All the factors that must be considered to account for the relative scarcity of rainfall in Mexico—such as geographical position in relation to air currents, cyclones, and air masses; topography; and mountain ranges that determine distribution of rainfall and consequently hydrology—are reviewed. The paper is completed by a table of maximum discharges observed in Mexican rivers and graphs that will enable comparisons with rivers of other countries. (Available November 1.)

39. Practical Design of Solid-Barrel, Reinforced-Concrete Skew Structures, by Bernard L. Weiner. The purpose of this paper is to show that, with sufficient accuracy for design purposes, the work involved in designing a skew structure may be reduced to little more than that required for a similar right-angle structure. Part of the work is reduced by making certain approximations which are permissible because of the stress characteristics of the skew structure. The work is further reduced by taking advantage of factors that follow directly from consideration of static equilibrium and are independent of skew-arch theories. (Available November 1.)

40. Technique of Passing Floods Over Earth Dams During Construction, by Andrew Weiss. An unvarnished account of success and partial failure in permitting flood flows to pass unhindered over uncompleted earth and rock-fill dams during construction is offered by the author. This necessity arises when absence of sufficient hydrologic data renders conventional by-pass provisions unsafe, as in Mexico, where rates of flood discharge in many streams are wholly unpredictable. The technique employed by Mr. Weiss (the originator) and his associates has demonstrated its practicability to a degree which invites consideration by engineers elsewhere. (Available November 1.)

D-XXVI. Discussion of Paper, **A Study of End Connections for Struts,** by Marshall Holt and J. W. Clark. The original paper, published in December 1949 PROCEEDINGS (p. 1477), presented the results of tests to evaluate the effect of different types of end connections on the static and fatigue strengths of struts. Interesting comment was received from Jack R. Benjamin, James W. Harland, F. P. Shearwood, and S. K. Ghaswala, and the authors contribute a brief closing discussion. (Available November 1.)

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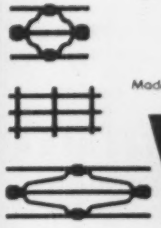

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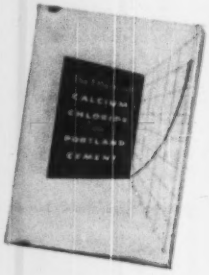

"The Effects of Calcium Chloride on Portland Cement" is a semi-technical book that clearly presents the facts on the use of Calcium Chloride. It is filled with graphs, tables, charts and contains much material not heretofore available. This information will be of great interest to contractors, architects, engineers, plant operators and men in allied fields. For your copy, write on your company letterhead to the address below . . . there is no obligation.

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- **CUTS DELAYS**
- **SPEEDS STRENGTH**
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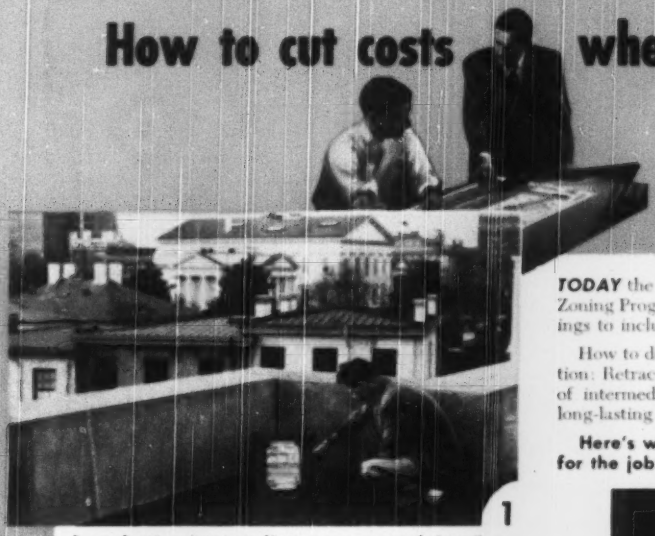
INDEX TO ADVERTISERS

AERO SERVICE CORPORATION	8
ALBERT PIPE SUPPLY CO., INC.	101
ALLIS-CHALMERS MANUFACTURING COMPANY	82
AMERICAN BITUMULS COMPANY	77
AMERICAN BRIDGE COMPANY	20
AMERICAN PIPE & CONSTRUCTION CO.	91
AMERICAN STEEL & WIRE COMPANY	99
ARKWRIGHT FINISHING COMPANY	90
BARBER-GREENE COMPANY	95
C. I. BERGER & SONS, INC.	106
BETHLEHEM STEEL COMPANY	63
BLUDWORTH-MARINE, DIV. OF NATIONAL-SIMPLEX-BLUDWORTH, INC.	108
BORDEN METAL PRODUCTS COMPANY	113
BROWN & BROWN, INCORPORATED	106
CAST IRON PIPE RESEARCH ASSOCIATION	6 and 7
CATERPILLAR TRACTOR CO.	5
CEMENT GUN COMPANY	107
CENTURY GEOPHYSICAL CORPORATION	94
CHICAGO BRIDGE & IRON COMPANY	59
THE COLORADO FUEL & IRON CORPORATION, WICKWIRE SPENCER STEEL DIVISION	81
THE COMMERCIAL SHEARING & STAMPING CO.	107
CONCRETE REINFORCING STEEL INSTITUTE	61
NORBERT DIENSTFREY	104
DRILLED-IN CAISSON CORPORATION	104
EASTMAN KODAK COMPANY	3rd Cover
ECONOMY PUMPS, INC.	16
GARDNER-DENVER COMPANY	15
GENERAL ELECTRIC CO.	1
HYSTER COMPANY	9
IMPERIAL PENCIL TRACING CLOTH	103
INTERNATIONAL HARVESTER COMPANY	2 and 3
IRVING SUBWAY GRATING CO., INC.	108
JOHNS-MANVILLE CORPORATION	64 and 65
KEUFFEL & ESSER CO.	10, 11, and 103
THE KINNEAR MANUFACTURING CO.	86
WM. P. KLEMP COMPANY	105
KOPPERS COMPANY, INC.	98
LAYNE & BOWLER, INCORPORATED	101
THE LINCOLN ELECTRIC COMPANY	69
LINK-BELT COMPANY	13
LOCK JOINT PIPE COMPANY	4th Cover
LONE STAR CEMENT CORPORATION	18
M & H VALVE AND FITTINGS COMPANY	100
MACARTHUR CONCRETE PILE CORP.	104
MERRITT-CHAPMAN & SCOTT CORPORATION	85
MORETRENCH CORPORATION	12
NEWPORT NEWS SHIPBUILDING AND DRYDOCK COMPANY	4
PERMUTIT COMPANY	17
PHILADELPHIA GEAR WORKS, INC.	14
PITTSBURGH-DES MOINES STEEL CO.	79
PORTLAND CEMENT ASSOCIATION	71
PROPORTIONEERS, INC.	75
RAYMOND CONCRETE PILE CO.	2nd Cover
REPUBLIC STEEL CORPORATION	87
SIMPLEX VALVE & METER COMPANY	93
SOLVAY SALES DIVISION, ALLIED CHEMICAL & DYE CORPORATION	114
SPARLING METER COMPANY	102
SPENCER, WHITE & PRENTIS, INC.	102
SPRAGUE & HENWOOD, INC.	108
STANCAL ASPHALT & BITUMULS COMPANY	77
UNDERPINNING & FOUNDATION CO.	106
UNION METAL MANUFACTURING COMPANY	73
U. S. PIPE & FOUNDRY COMPANY	83
U. S. STEEL CORPORATION	20 and 99
VIBER COMPANY	92
DAVID WHITE COMPANY	97
WICKWIRE SPENCER STEEL DIVISION OF THE COLORADO FUEL & IRON CORPORATION	81
JOHN WILEY & SONS, INC.	103

How to cut costs when drafting revisions are necessary

* A case history based on the experience of the Virginia Department of Highways



1

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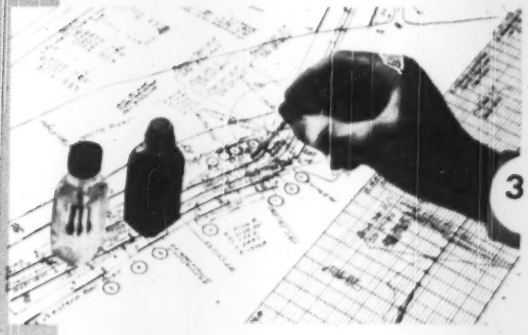

3

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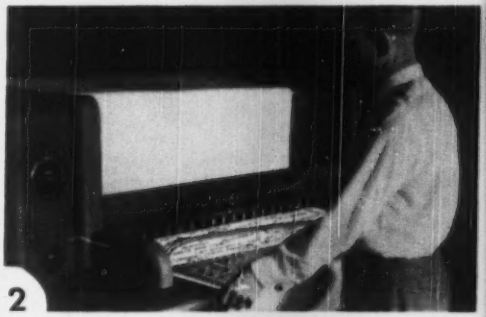

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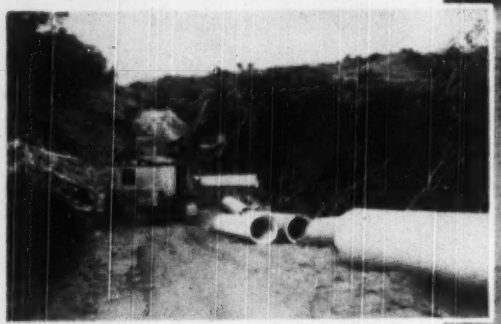

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